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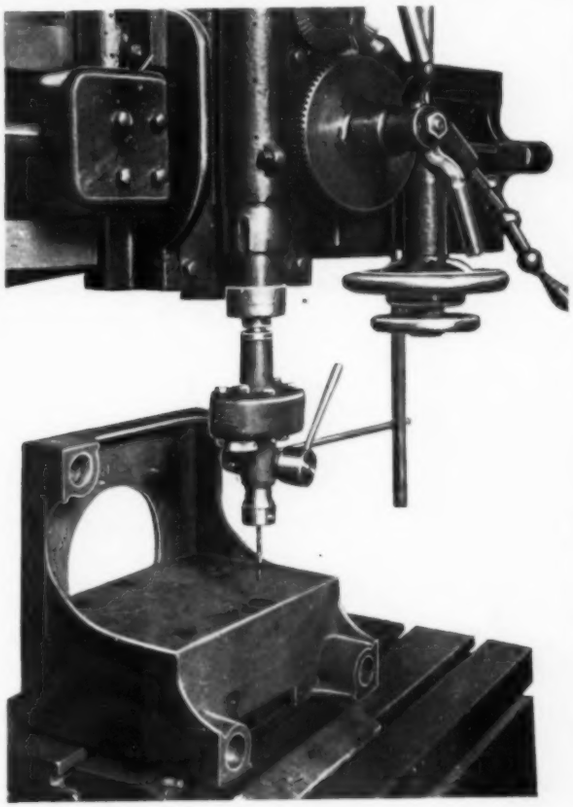

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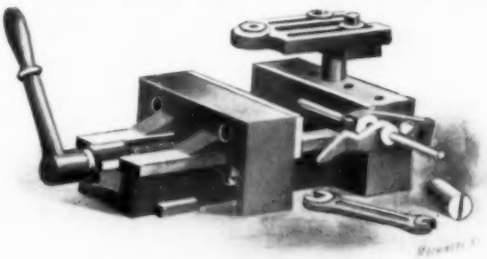

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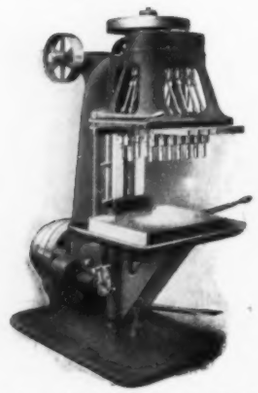

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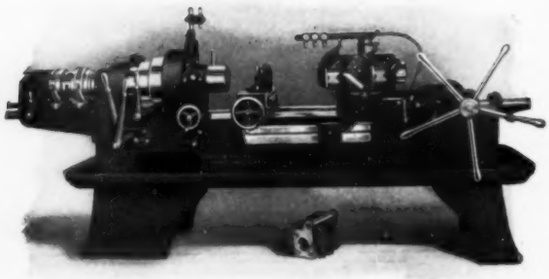

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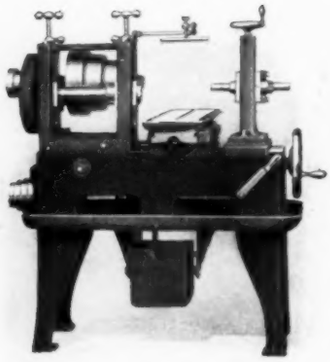

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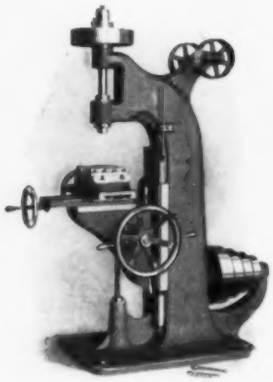

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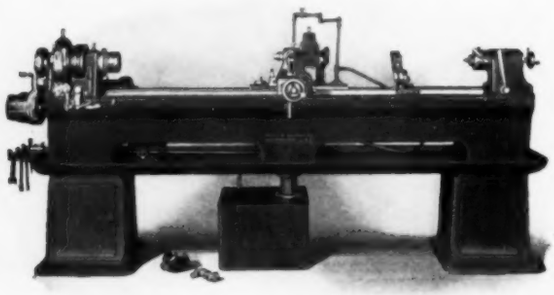

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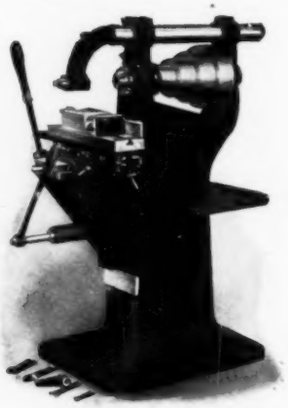

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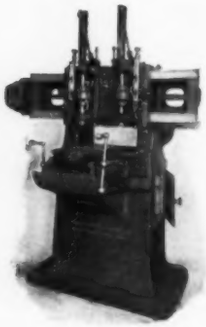

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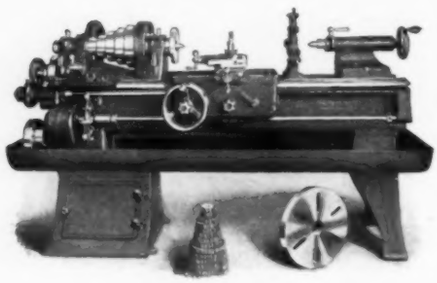

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A NOVEL BLOWING ENGINE

An Entirely New Positive Valve Motion Giving Extra Large Valve Areas

EDITORIAL CORRESPONDENCE

In air-compressor and blowing-engine work the valve problem grows rapidly with decrease of pressure, areas of opening which are ample for high pressures being entirely inadmissible with low. This, to many, unknown fact arises from the circumstance that the lost work due to forcing the air through the valves becomes a larger and larger percentage of the useful work as the pressure is reduced, a loss which would be negligible, when considered as a percentage of the work necessary to produce a high pressure, becoming entirely inadmissible when considered as a percentage of the work involved in compressing to a low pressure.

LOSSES IN HIGH- AND LOW-PRESSURE MACHINES COMPARED

When compressing air to, say, 80 pounds, the theoretical mean effective pressure is about 35 pounds. A suction loss of, say, ½ pound would represent a power loss of $\frac{0.5}{35} = 1.43$ per cent., which would not be a serious matter. When compressing, however, to five pounds the theoretical mean effective pressure would be about 4.5 pounds, and the same suction loss would represent a power loss of $\frac{0.5}{4.5} = 11.1$ per cent., which has a very different look. Obviously the lower pressure requires the larger port opening. The same consideration applies to the loss due to forcing the air through the discharge valves, but to a still greater degree. The loss here, when compressing to high pressures and measured by the pounds by which the pressure within the cylinder exceeds that within the receiver, is much greater than the suction loss; but the length of the surplus area on the indicator card is but a small portion of the length of the card, and hence the area representing lost work is again but an insignificant percentage of the area of the entire card. As the pressure is reduced, not only does the surplus pressure become a larger percentage of the mean effective, but the length of the lost-work area occupies a larger part of the length of the card, and hence the percentage of lost work increases in a compound manner.

DIFFERENT CONSTRUCTIONS NECESSARY FOR HIGH AND LOW PRESSURES

In the style of compressor having poppet valves in the cylinder heads, it has always been the practice to utilize the entire available space for valves, but to give the larger part of it to the inlet valves and, for high pressures, this practice is sound.

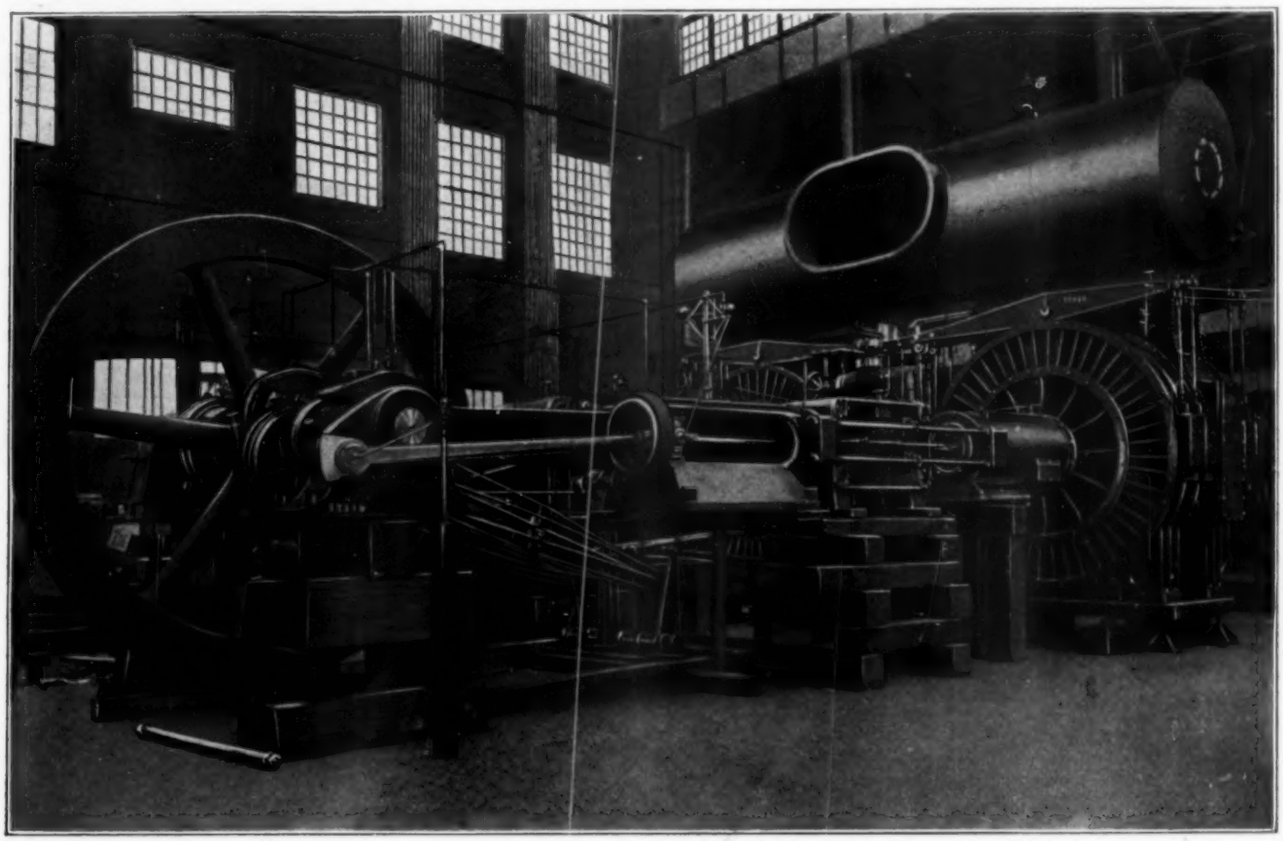


FIG. 1. NORDBERG BLOWING ENGINE

The first necessity is to get the air into the cylinder, and the effect of the short length of the discharge line is to make admissible an excess of pressure at this point which, considered from the lost work standpoint only, could not be tolerated if it appeared as a suction loss.

With reduced pressures, however, the lengthening of the discharge line makes additional discharge-valve area imperative; but, with the construction now under consideration, this is possible only by reducing the inlet-valve area, although, as shown above, an increase is called for by the conditions.

These remarks, brief as they are, serve to show that the valve problem of low-pressure machines is not merely one of valve area but of general construction by

which the desired area can be secured, a construction which gives satisfactory port areas at high pressures becoming economically impossible at low, since with it the required areas cannot be obtained.

THE FRICTION LOSS OF HIGH- AND LOW-PRESSURE MACHINES

Another source of loss—that of the friction involved in driving the machine itself—becomes of increasing importance as the pressure is reduced. Comparing a blowing engine with an air compressor of the same horse-power, we have in the former a large air cylinder attached to a small engine. The air pistons and valves cannot be lightened with the reduced pressure, but, on the contrary, they naturally grow heavier as the cylinder bore is increased. The result is a combination of large, heavy parts doing very light duty and a much larger friction loss than in the case of a compressor of the same horse-power.

A NEW CONSTRUCTION

We illustrate herewith a highly novel and interesting—and, we may add, entirely successful—blowing engine, which was recently supplied to the Tennessee Copper Company by the Nordberg Manufacturing Company, of Milwaukee, Wis. Its design is intended, first, to provide unusually large valve areas, and, second, to avoid the drag due to the friction of large and heavy air-cylinder parts. The machine was designed for an ultimate air pressure of 40 ounces per square inch, the running pressure at present being, however, but 34 ounces. The engine is compounded with Corliss cylinders of 15 and 33 inches bore, the air cylinders having a bore of 70 inches. The stroke is 42 inches. The blowing-cylinder valves have an opening of 40 per cent. of the area of the piston—this figure belonging to both inlet and discharge valves, and being, I believe, unapproached in any previous machine of this character.

THE PORTS AND VALVES

General views of the machine as it stood on the erecting floor are given in Figs. 1 and 2, while Fig. 3 shows a longitudinal section of the air cylinder. Referring to Fig. 3, it will be seen that annular ports *a a b b* are built up around each end of the cylinder. These ports involve, of course, considerable clearance space; but, at the pressure for which the machine was designed, the effect of clearance is inappreciable. Clearance loss decreases with the pressure, and at the pressure here used the action more nearly approaches that of a pump, where it disappears entirely, than that of a compressor, as that term is commonly understood.

The opposing sides of these ports are formed into ring gridirons, on which the corresponding ring gridiron valves *c c d d* work, *c c* being the suction and *d d* the discharge valves. Fig. 4 is a detail of one of the inlet valves, with some of the leading dimensions, and Fig. 5 shows a portion of a valve seat.

The valves are in four segments in order to permit placing them in position. In action they oscillate over the port seats, opening and closing them as required. While of light section, they are, of course, in the aggregate heavy, and as they have a wide and free motion, they would, if supported on trunnion bearings of their inside diameter, give a very appreciable friction load to the engine as well as be subject to wear. To avoid this, they are bored to a diameter considerably in excess of the outside of the cylinder, clearing it freely, as shown at *e*, Fig. 3. Ears *f*, Fig. 4, are bolted at the ends of the horizontal diameters, and from these ears the valves are hung by swiveled suspension rods, which pass up through stuffing boxes and are attached at their upper ends to walking beams, as shown in the half-tones, and more clearly in the end view, Fig. 6. These beams are supported on trunnions at their centers, the friction of which is all to which the weight of the valves gives rise. The beams are extended inward and are driven by rods *g*, which, at their lower ends, are connected to Corliss wrist-plate mechanisms, by which the valves are positively driven. The suspension rods by which the valves are hung are shown at *h*.

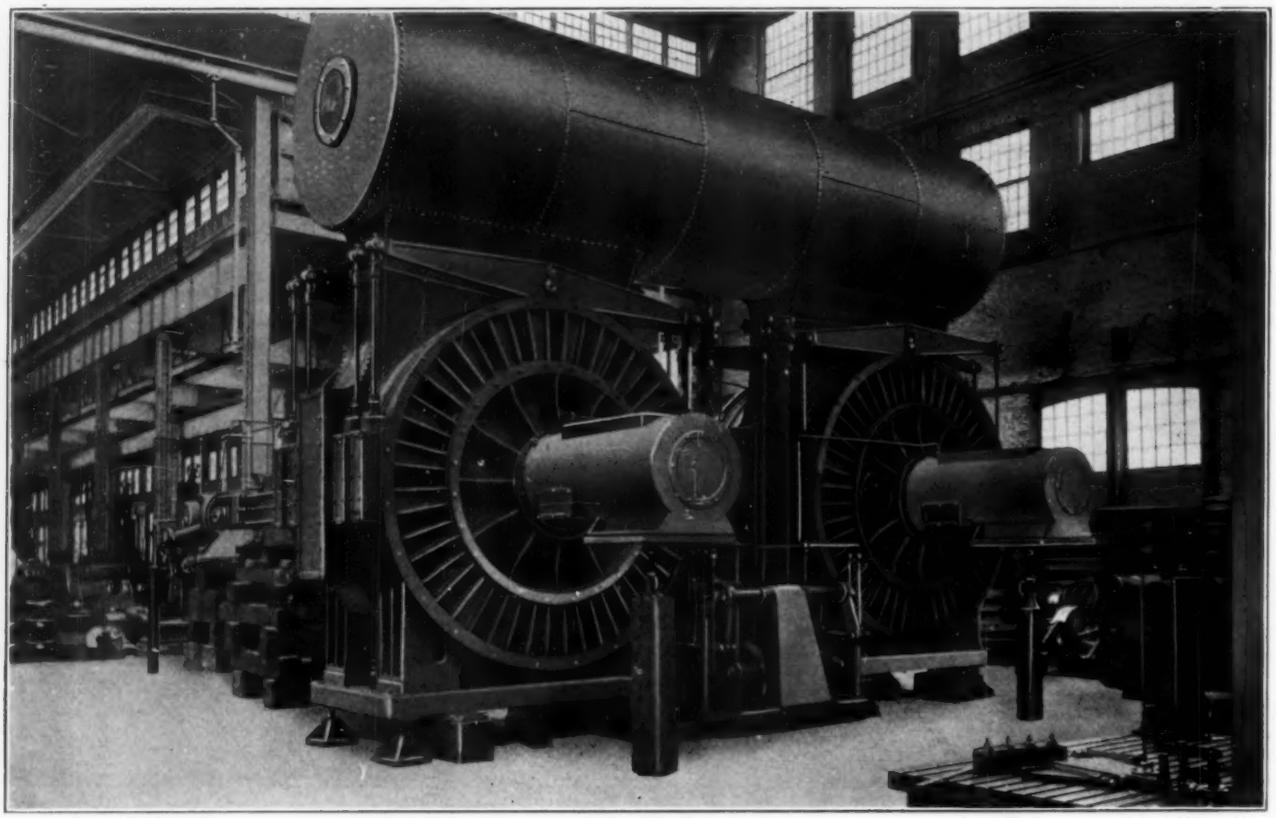


FIG. 2. NORDBERG BLOWING ENGINE

THE WRIST-PLATE MECHANISM

Fig. 7 shows the support of the wrist-plate mechanism and the mechanism by its center lines. The inlet and discharge valves are driven by separate eccentrics, *i*

being the inlet and *j* the discharge-valve eccentric rods. Rod *i* connects at *k* with the inlet, and rod *j* at *l* with the discharge gear. A rod *km* connects the plates for the inlet gears for the two ends, as shown also in Fig. 3, while a common plate at the center serves for both discharge gears. Each wrist-plate motion is double, two such plates intervening between each eccentric rod and the valve rod, both plates passing their idle arcs at the same time. The second plates are centered at *n* and *o*. The effect is to greatly increase the characteristic dwell of the device, extending the range of the idle arc and making it more nearly completely idle than with a single plate. The idle arc is, of course, made use of in order to reduce the movement of the valve after closure, by which two results are secured—first, reduced friction and wear when the valve is closed with the load upon it; and second, a larger aggregate port area than would otherwise be possible. This last result is not obvious at the start, but will appear presently from the description. As a matter of fact, the 40 per cent. port area which these valves give would be impossible without this double wrist-plate mechanism.

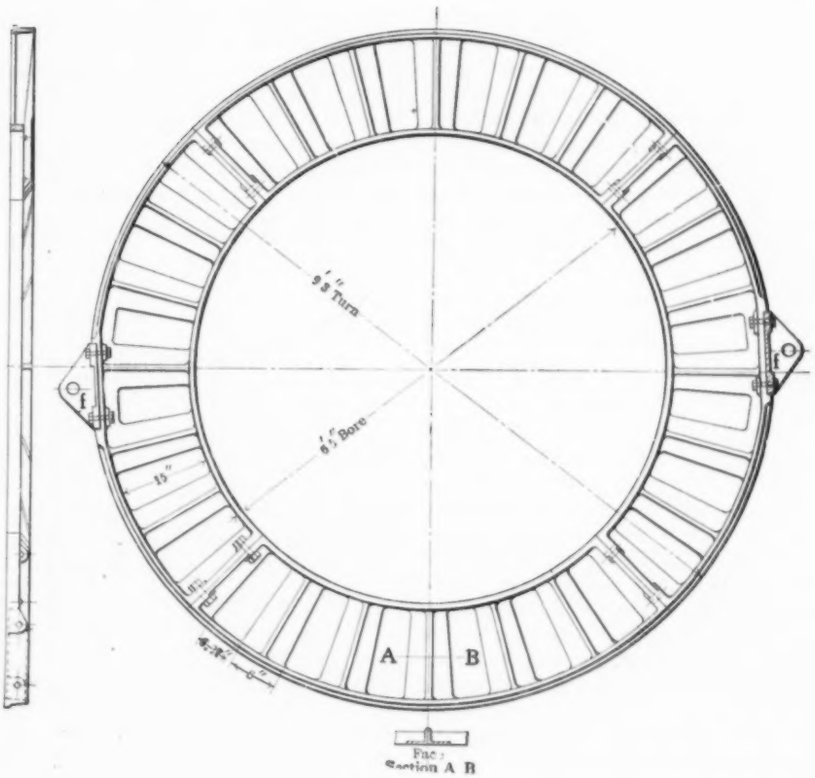


FIG. 4. INLET VALVE

THE ACTION OF THE MECHANISM

Fig. 8 shows the action of the mechanism by comparing the movements of the inlet valve with the movements which would take place if the eccentric rod were connected directly to the valve. The full lines show the valve on its seat, and in a succession of positions, such as would be given it by a direct connection to the eccentric, while the dotted lines show the corresponding positions actually given it by the plates. Beginning at the top, the valve is fully open in both cases from which point the action is not markedly

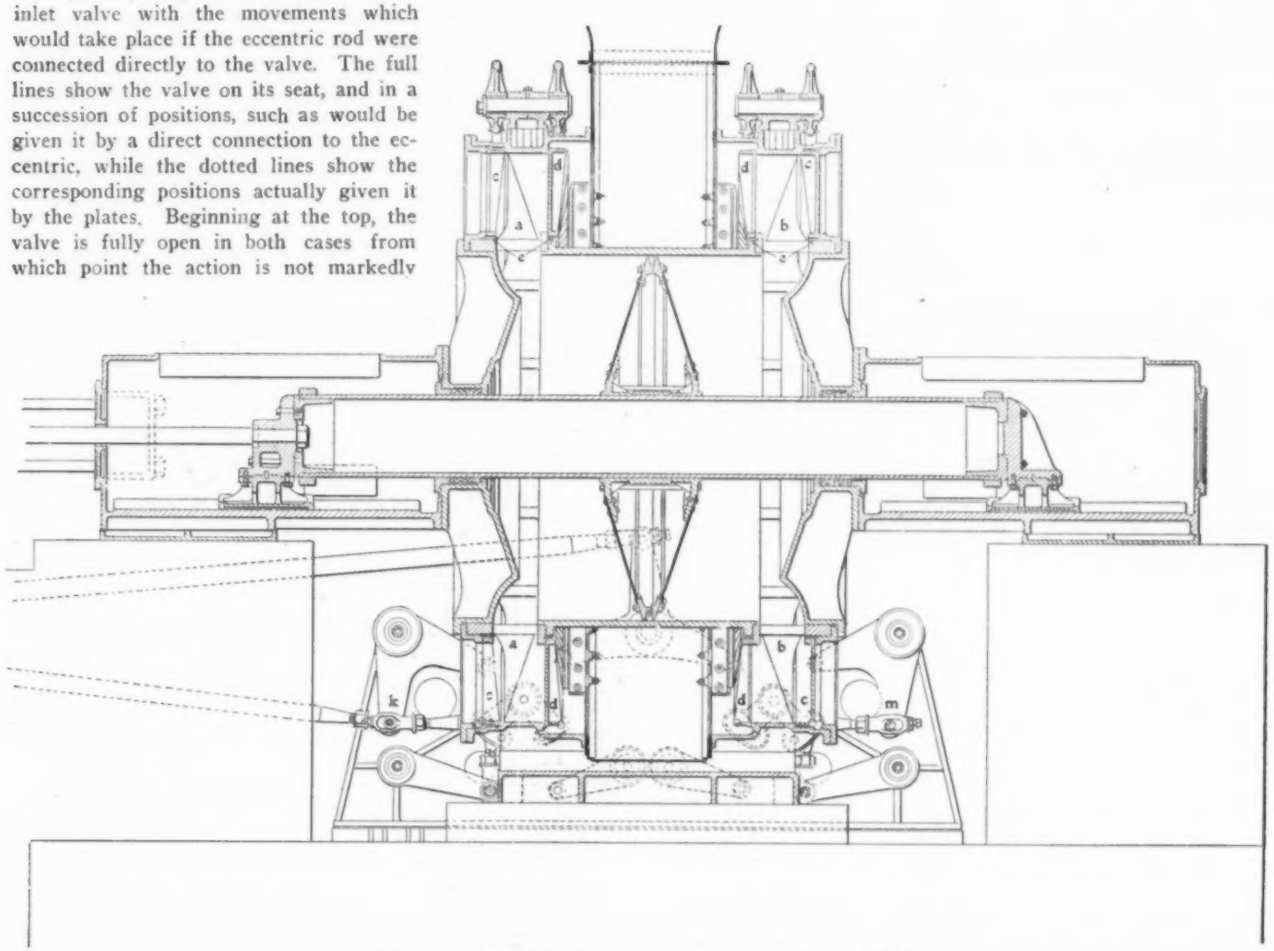


FIG. 3. LONGITUDINAL SECTION OF BLOWING CYLINDER

different until closure at p, when a marked change takes place. With the direct connection the valve continues to move until at q it covers the port by a width equal to its previous opening, this being characteristic of slide valves having no lap;* but with the actual mechanism the dwell of the wrist plates comes into play as soon as the ports are closed, the result being that the valve covers the port but a small amount, the extreme cover being at r, from which it gradually decreases. Were the opening movement to be plotted, it would simply retrace the positions shown in reverse order.

INCREASED PORT AREA

The width of the valve in order to prevent reopening by the rear edge must obviously be determined from the position of extreme cover and, with the direct motion, its value is obviously $q\ s$. Laying down this width on the top section, we have the point t where the edge of the next port must be located in order to prevent that port being covered by the back edge of the valve in its open position With the actual motion the width of the valve is reduced to $r\ u$ and, laying down this width on the top section, we have the point v for the position of the edge of the next port. Comparing the two constructions, we have the distance w for the space occupied by a port and seat with the valve directly driven, and x for the corresponding space when the wrist plates are used, the width of the port being the same in both cases. The total circumference of the valve divided by w and x obviously gives the number of ports which can be got into the circumference by the two arrangements. The total port area being proportional to the number of ports, the ratio of the reciprocals of w to x obviously gives the increased port area which is made possible by the wrist-plate mechanism.

*As a matter of fact the valves have a slight lap, but this has been ignored in making the diagrams.

THE CONSTRUCTION OF THE AIR PISTONS

The light duty added to the large diameter of the air pistons has led to the special construction, shown in Fig. 9. The pistons are made of ⅜-inch boiler plate, each side in one piece and dished to the form shown. Lateral stiffness is provided by riveting the plates at the outer diameter to a ring spider in halves, the piston-ring groove being between the halves. The piston is turned 2⅜ inches smaller than the bore of the cylinder and the ring does not bottom in its groove. The piston is thus a floating piston, and its weight cannot be carried by the cylinder, but is carried by the piston rod. This rod, as befits its duty, and as shown in Fig. 3, is extremely light. It is made of steel pipe and its diameter provides ample stiffness. Each end carries a shoe for supporting the weight of the piston, the shoes and their guides being shown in Fig. 3.

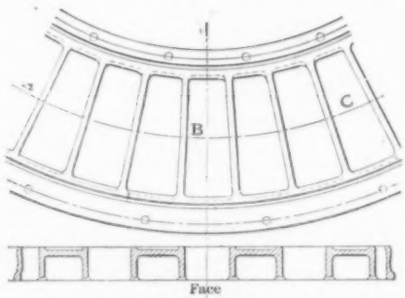


FIG. 5. INLET VALVE SEAT

INDICATOR DIAGRAMS

Fig. 10 shows a pair of indicator cards (reduced in size) from the blowing cylinder, the speed and pressure being noted thereon. The discharge lines will be seen to contain the usual undulations, but in estimating their size the scale of the spring must be kept in mind. In the original cards the scale is two pounds per inch and, scaling them, the extreme rise above the receiver pressure line scarcely exceeds ½ pound. Such a rise on a card taken with the usual spring would hardly be noticeable, and the card would be passed as, in this respect, perfect.

As a matter of fact the undulations in these cards are not due to the valve action, but to the inertia of the air surging through the receiver and pipe line. There is plenty of other evidence that this inertia is very appreciable, both in air and steam. Indicator cards from the steam chests of cut-off engines often show a rise in pressure above the boiler pressure immediately after the closing of the valve, the rise being due to the inertia of the steam developed by its surging forward after stoppage of its flow to the cylinder. The present cards also give evidence of the inertia action in the dropping of the discharge lines below the receiver pressure line. Were the rise in pressure above the receiver pressure line due to the forcing of the air through the ports, the pressure

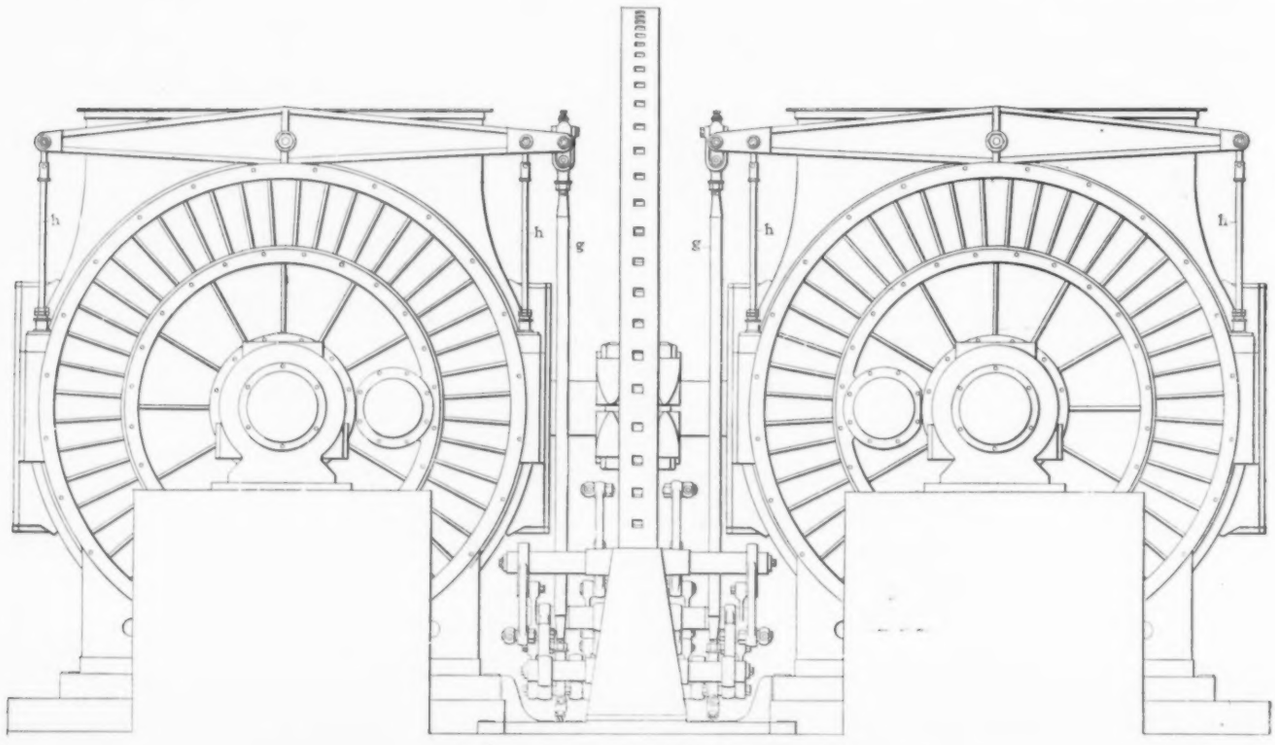


FIG. 6. END VIEW OF BLOWING CYLINDER

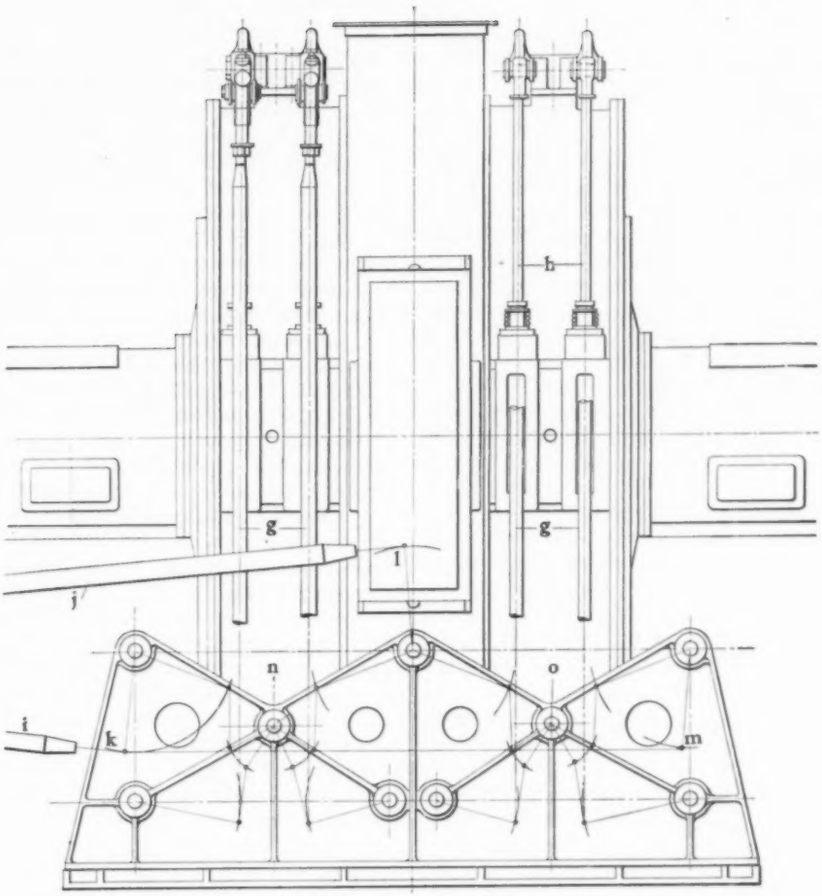


FIG. 7. WRIST-PLATE MECHANISM AND SUPPORT

would necessarily lie entirely above the receiver pressure line.

It will be observed that the removal of the two rows of bolts which hold the two sides of the piston together permits the sliding back of one of them on the piston rod, thus giving access to the packing ring

The suction line will be seen to be remarkable. Remembering the scale of the spring, a single ounce of suction loss would show in the original cards by a drop of 1/32 of an inch in the suction line below the atmospheric line. In point of fact no drop is visible. F. A. H.

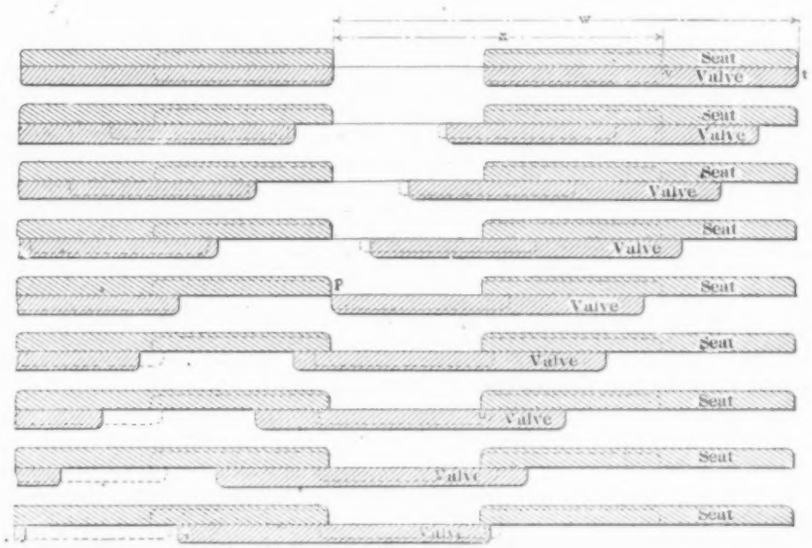


FIG. 8. THE ACTION OF THE WRIST-PLATE MECHANISM ON THE VALVE

Variable-speed Devices for Pedal Bicycles

The people who took up bicycling as a fad and, like most faddists, soon got tired of it, will now tell you that bicycling is dead; however, it must be rather a lively corpse, for, instead of having reached the limits of perfection, improvements in the design of the machine continue to be made. At the English Stanley Show the most prominent feature was probably the exhibit of several variable-speed gears, most of which depend upon the epicyclic or planetary-gear principle. Two-speed gears have made their appearance in the

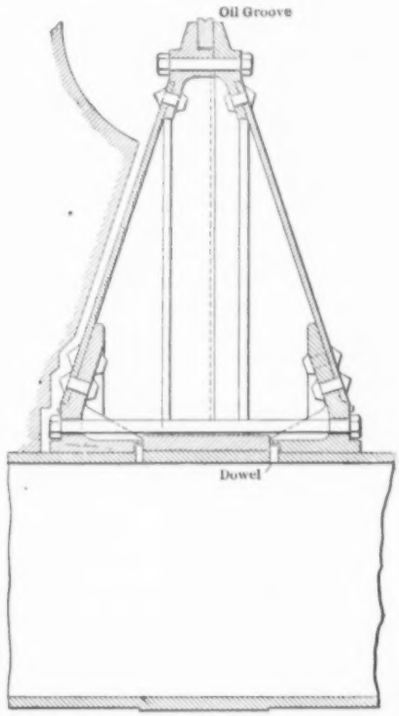


FIG. 9. AIR-PISTON CONSTRUCTION

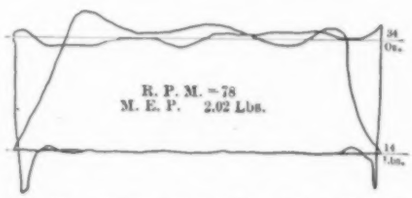


FIG. 10. INDICATOR CARDS FROM BLOWING CYLINDER

United States, but one would suppose that for the greater part of the time the low gear is a little too low and the high gear a little too high; so that, except for its greater weight, the three-speed gear, of which many are now being made in England, would be superior, since it gives a medium gear for average conditions. The *Cycle and Motor Trades' Review* (England) is publishing a series of illustrated descriptions of these interesting pieces of mechanism, the ratios obtained varying from a 15 per cent. reduction to 50 to 112.

THE COST OF A GOLDEN AGE

The Debit Side of the Patent Account

BY A. S. FITCH

The last half of the past century together with the early days of the present, covering a period of some sixty or seventy years, is popularly considered the most brilliant era in either history or tradition; an era in which the greatest achievements in science, discovery and invention have been made, yielding a larger and more general betterment to the human race, in the conditions in which it now exists, than ever heretofore attained. During this golden age the telegraph, wired and wireless, the submarine cable, the sewing machine, the mower, the reaper, harvester and binder, the modern steam engine, the manifold appurtenances of land travel, the ocean greyhound, the telephone, the phonograph, the marvels in electrical appliances for the generation and utilization of the fluid for illumination and power, and the wonders in automatic and labor-saving machinery, have all been conceived and brought to their present perfection. Things of which our forebears never dreamed as possibilities, and many which even those still living looked upon as little less than miraculous when first announced as accomplished facts, are now the ordinary necessities of daily life on every continent and in every land under the sun.

THE OTHER SIDE OF THE ACCOUNT

While it may not be denied that this age of materialistic wonders has bestowed innumerable blessings upon mankind from an ethical viewpoint, in that never before in the history of this planet could man get so much of comfort and luxury in life by so small an expenditure of labor, either with hands or brain, as now, there is another aspect in which it may properly and profitably be viewed, weighed and measured, which has seldom, if ever, been seriously considered. How little thought has been given to the actual cost of this great era? Not in the brain-fag of the thinker; not in the muscle-weariness of the explorer, the experimenter, the laborer; not in the sadness and grief over disappointment and failure, oft repeated in the fields of invention and discovery; not in the bitter sorrow and despair over unrequited zeal; but in the monetary cost—the cost in the gold that has been wrested from the bosom of our old Mother Earth to deck her with the glories of her golden age—in hard, metallic coin, the final and definite measure of value of everything in these practical days.

PATENT-OFFICE RECORDS OF COST

Apart from the revelations given to men by philosophers and great scientists, whose labors were largely speculative, involving little of material cost, and whose voices were more as of those crying in the wilderness than like the lusty ring of the blows of the smith at his forge, there is no surer index to the financial cost of modern achievement than the records of the governmental patent offices of the world. There we find facts which are unassailable and unquestionable; for through them have passed myriads of scientific and mechanical inventions and discoveries, among them all that we call the great inventions, as well as the hundreds of thousands which have played minor parts in the world's work, or have been lost in the oblivion of failure and disuse. From these facts may be deduced further facts of approximately equal reliability, so that a tenable basis may be constructed for a reasonable and conservative estimate of the actual cost of this golden age.

Since the foundation of the patent system, over three and a half million applications for patents have been made to the various governments of the world, and very nearly two and one-half million letters patent have been granted. These figures do not include copyrights, trademarks or the registration of labels, all of which are, however, in some measure, more or less linked with or concomitants of "inventions." Of the total number of patent applications, about one-half have been made to our own government, and the United States of America has issued, up to date, about one million patents. Moreover, nearly, if not quite, seven-eighths of this activity in invention has occurred during the past fifty years.

THE AGGREGATE OF GOVERNMENT FEES

The filing of these applications for patents in this country has involved the payment to our government by inventors and applicants of about $50,000,000, and to the other governments of the world from about $85,000,000 to $90,000,000. But these fees payable to governments are only a drop in the bucket in comparison with the other expenses involved in obtaining patents. The fees and charges of the solicitors or agents who prepare and prosecute these applications must be taken into account. There are hundreds, yes, thousands, of instances in this country, especially during the past thirty or thirty-five years, in which expert attorneys of high standing have charged and received anywhere from $1000 to $3000 for the preparation of the specification and drawings of a single intricate and important invention. A case is on record in which the solicitor labored for one entire year exclusively on one specification, receiving, as his fee, a check for $10,000. This was exceptional to be sure; but very heavy fees are frequently charged in difficult cases.

SOLICITORS' FEES

Without attempting to itemize these larger fees, it is not unwarrantable to state that, in at least one-half of one per cent. of all the applications filed in the United States patent office, the fee paid the solicitor in each case has amounted to not less than $1000; in another 17,500 cases to not less than $500; in 5 per cent. of the total number, or 87,500 cases, not less than $250; in 10 per cent., not less than $100; in one-third of the entire number, $50; and that, in the remaining one-half of all cases, the ordinary fee of $25 to $30 has been charged. These figures, if they err, do so in their moderateness rather than excess; and thus reckoned, the total sum paid to American solicitors foots up nearly $100,000,000, or an average of about $60 per application. Anyone familiar with the profession of patent soliciting will recognize the conservatism of these figures and the probability that the average cost of a solicitor's services has been nearer $100 in each case than the $60 above given; so that the nearly 2,000,000 applications for United States patents, including government fees paid, has undoubtedly aggregated about $200,000,000.

But, as about one-half of the total number of applications filed at Washington has been rejected and patents thereon have never been granted, this total cost of $200,000,000 is properly chargeable, in reckoning the debit side of this great account, against the million patents which have been granted in this country. Thus, the charge for this item against issued United States patent would average $200 each, a moderate figure when all circumstances are considered.

THE COST OF EUROPEAN PATENTS

Until within a very few years, the fees, both governmental and to solicitors for applications in European and other foreign countries, have been considerably greater than those averaged in the United States; besides which, fees for the prolongation of these foreign patents year after year have had to be paid. It is entirely safe to state that the cost of procuring and maintaining the nearly 2,000,000 patents granted in foreign states has been at least three times the cost of the like number of patents in our own country, or about $600,000,000. This gives a grand total of very close to one billion dollars expended by inventors throughout the world during, say, about 100 years, for governmental and solicitors' fees alone in connection with the applications filed in that period.

ABANDONED CASES

This billion of dollars covers only the instances in which the attempts to protect inventions has proceeded thus far; but the records and files of the host of solicitors throughout the world, and especially in this country, will disclose a vast number

of cases in which, because either of change of purpose or of lack of funds on the part of the inventors, the applications have been cast aside or abandoned after entire or partial payment for their preparation; so that it is entirely reasonable to add to the total debit of this item of cost a further sum which will swell the amount already named to nearly two billions of dollars.

PRELIMINARY EXPENSES

But, even yet, we have only begun to count the cost. There are other items of such colossal proportions that they are appalling in their magnitude. These are the expenditures involved in the preliminary or embryo stage of an invention or discovery, and necessary to demonstrate or at least indicate its probable practicability and worthiness to be made the suoject of an application for a patent. Under this head, as well as any other, may be placed the cost of models illustrating, in miniature, the features of the invention. For many years the model halls of our patent office contained tens of thousands of models which represented the expenditure of millions of dollars in their construction by or for inventors. Of late only the more important of this great array of models have been retained by the office; and while the filing of a model of an invention for which application for a patent is made is now no longer compulsory, except in certain special instances, the production of models by inventors still goes on, as many of them think it a necessary step in development.

DEVELOPMENT EXPENSES

Then there is the cost of thoroughly and practically developing the invention and getting it into final condition for commercial or public usage. Further than this are the disbursements for legal advice, in very many instances, concerning the scope and validity of the patent, and the still greater fees and expenses connected with litigation in court to enforce, defend or maintain the patent right. And, further again, is the capital drawn into partnerships or corporations formed for the purpose of exploiting and selling the patented thing in the markets of the world, a large part of which is lost through the failure of the invention to meet the popular demand. We have heard much of some few great fortunes made from certain radical inventions; but it is only now and then that we learn what it has cost in litigation and other expenses to protect the patents on these inventions, and to realize the advantage the monopoly is supposed to bestow upon its possessor; and we rarely notice or consider the scores of thousands of invention and patent wrecks which strew the shores of the commercial seas, gaunt witnesses of failure, disaster and financial loss.

In the preliminary stage, many inventions, notably those that have first blazed a trail through some theretofore unexplored jungle of physics, have involved years of labor and the expenditure of thousands of dollars before their feasibility and utility were demonstrated. But grouping these greater and fundamental inventions with others of large importance in like fields of discovery, it is not unwarrantable to assert that at least 1 per cent. of all have averaged over $10,000 each in preliminary development, although a great number have thus cost ten or twenty times as much; that another 1 per cent. has averaged $15,000; 5 per cent. $2500; 20 per cent., $1000; another 20 per cent., $500 each; still another, $250; and the remaining third, $100 each. The total of these figures is close to two and one-half billions of dollars; and this total is probably below rather than above the true sum.

Another item comprises the expenditures involved in this preliminary development of those inventions which fail of satisfactory demonstration, and consequently never appear as subjects of applications for patents. There can be no absolute accuracy in estimating the exact number of these cases, but they have occurred over and over again and are witnessed daily. That they almost, if not quite, equal those which have proved practical there can be little doubt. But if they are set down as only one-half such number these abandoned efforts will add at least another billion and a quarter of dollars to our debit.

The final development of patented inventions has certainly exceeded in cost that of their preliminary demonstration. At this stage inventions are brought to practical form and generally demand the construction of machinery or apparatus. Hundreds of thousands of dollars have frequently been thus expended in individual instances only to be totally lost in the end. We can easily count the great or even ordinary successes of exploited patents; but their financial wrecks are as the sand on the seashore. But, disregarding individual cases and applying the same percentages and ratios of expenditure for this item as are given for preliminary development, we have a total of two billions and a half of dollars for this additional debit. It can, by a little figuring, be proven that this item more nearly approximates five billions of dollars than the sum first named.

THE COST OF LITIGATION

Litigation has called for the expenditure of enormous sums. Not one of the great, fundamental inventions has escaped this outlay for the enforcement or defense of its rights under patents. From 1867 to 1885 the United States courts were crowded with these cases all over the country, and the eminent counsel engaged received from $100 to $1000 per diem for their services, which continued in many cases for several years. Instances of very large fees, some as great as $100,000, or even $250,000, were known. Since 1880 the litigation concerning electrical inventions has greatly increased. Of course, all patents have not been litigated; but certainly, at least, one-half of all granted here or abroad, have called for some expenditure on this account or, at least, for legal advice, and it cannot be far from the truth that, taken together, they have averaged $1000 in each instance, and that the total of this expenditure aggregates at least one and one-half billions of dollars.

PROMOTER'S CHARGES

The final item should cover the losses suffered by investors in patents whose money has gone, not into the development or actual exploitation of inventions, but into the pockets of promoters and schemers for worthless title interests in the patents themselves, or for the inflated stocks of corporations holding the patents. This sum must be enormous, but can only be surmised from known facts. In a single State in our Union corporations capitalized in stock to over twenty-five millions of dollars were dissolved during a single year, and most of them were closely related to some patented monopoly. One patent scheme drew, in one year, over £3,000,000 out of Great Britain, and fell to pieces before another twelve months. Two other American inventions were exploited there in the early eighties, which proved a total loss within two years of £1,000,000 to the stockholders. That the loss to investors in patent rights all over the globe during the past sixty years has been billions of dollars cannot be doubted, when the fact is recognized that not over 10 per cent. of all patents ever actually yield a financial profit any greater than that derivable from an unprotected article in the open market. It is more probable than not that this item of lost capital put into patents which have proved chimerical or been abandoned for other reasons, amounts to not less than three billions of dollars.

THE GRAND TOTAL

When the items of this great debit against our golden age are added up, they give a grand total of nearly fifteen billions of dollars; and, adding interest at 6 per cent. per annum for a term of thirty years, as nearly all this vast sum has been expended for the purposes stated during the past sixty years, we have a final total of debit to the account of modern invention of almost forty-five billions of dollars. This almost inconceivable sum is greater than the national debts of all the countries of the world.

A serious contemplation of these facts naturally suggests the question: Have the successful inventions of our golden age in and of themselves yielded to their inventors and owners an actual money-profit adequate to offset this colossal debit and show a balance on the right side of the world's great ledger?

THE MODEL-MAKER OF MAIDEN LANE

Some Fine Marine Models—A Few Things Done in a New York Shop

At the St. Louis Exposition of 1904 there were few exhibits of greater interest to the visiting public than those installed in the Government building, to represent various important features of the different departments; and of these displays none was more attractively arranged than that of the Department of the Navy. It had as its most conspicuous exhibit a full-size model of a portion of a low-free-board type of battleship, representing faithfully the exterior and interior of this class of vessel, from the bow to a distance aft of perhaps 120 feet, this being approximately one-third the total length of the man-of-war, to whose lines the wooden model was molded.

SMALLER MODELS

Grouped about this structure there were, among other exhibits, some twenty-odd models of war vessels constructed to a scale of ¼ inch to the foot, and illustrating the development of our modern navy. The finest examples in this group represented the 16,000-ton battleship "Connecticut," then building at the New York navy yard, and the 14,500-ton armored cruiser "Tennessee," under construction at the time by William Cramp & Sons, of Philadelphia. These masterpieces of the model-maker's art, and several other reproductions to the same scale of earlier naval vessels, were constructed and the whole exhibit erected under the supervision of H. E. Boucher, who for several years held a position of responsibility in the department of construction and repair at the Washington navy yard.

A BIT OF PERSONAL HISTORY

Some little time ago he resigned his situation with the Government to engage in business for himself, and is now located in a shop in Maiden lane, New York City, where, with a force of a dozen or fifteen men, he constructs models of various types of boats and ships, and designs and builds special machinery.

Mr. Boucher is a naval architect, and for some fifteen years prior to removing to Washington was engaged as a draftsman and designer in the New York navy yard. His employment there in the department of construction and repair enabled him to become thoroughly conversant with the details of naval and other vessels, and quite early he became interested in the making of models; upon being transferred to Washington he was naturally well qualified to take up this work in the shops of the navy department.

ACCURACY AND ATTENTION TO DETAIL

The product of these shops, as shown at St. Louis, and the models produced by the H. E. Boucher Manufacturing Company, must by no means be confounded with the ill proportioned, gaudily decorated miniatures or caricatures of deep-sea vessels carved out by industrious sailor men and exhibited in dry dock or at anchor in the swing-door havens of the Bowery coast. The real *models* are constructed accurately to scale from the ship builder's drawings, and from stem to stern their hulls reflect faithfully the lines and curves of the original vessels, while everything visible above decks is reproduced with the same degree of truth, except in a few instances where certain parts may be of such small dimensions as to be likely to vanish entirely if the scale adopted were in their cases rigidly adhered to.

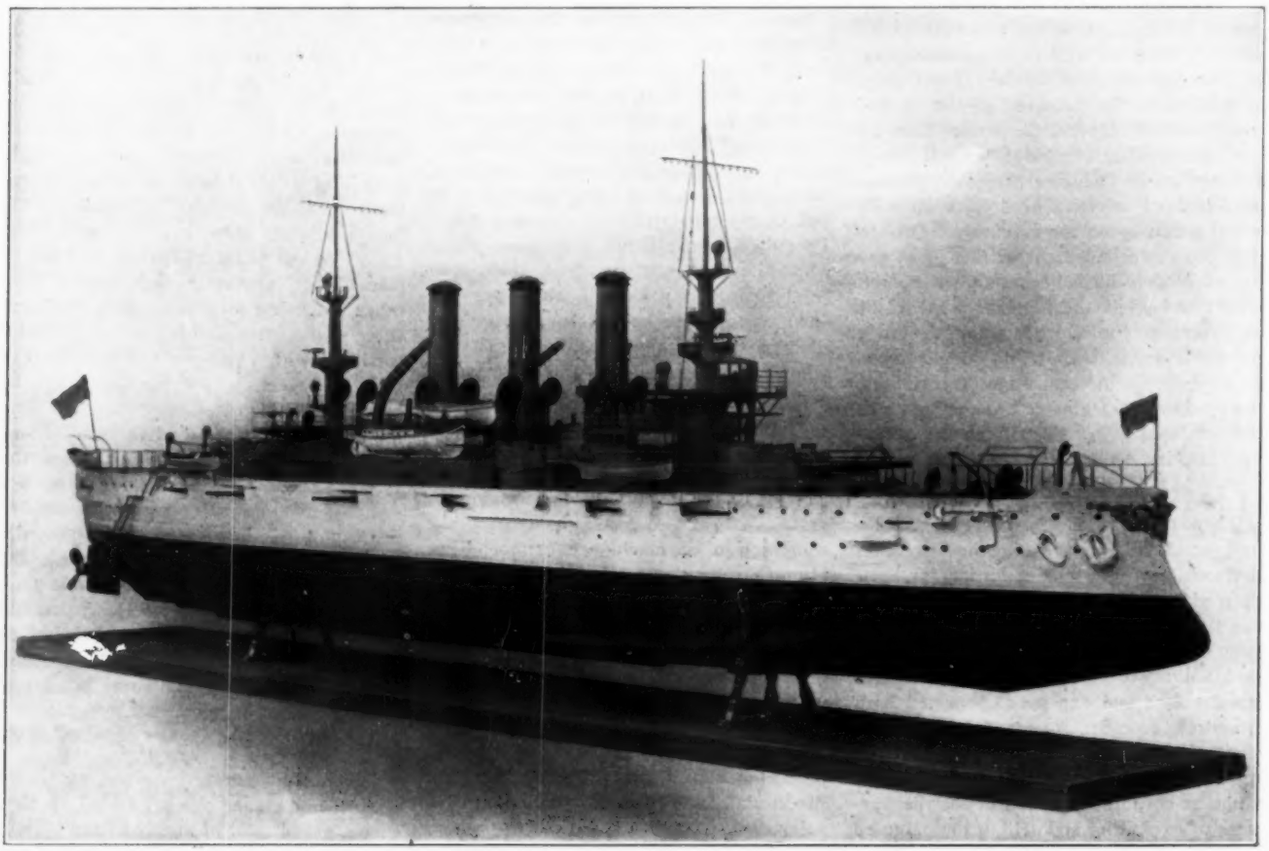


FIG. I. MODEL OF U. S. BATTLESHIP "CONNECTICUT"

THE "CONNECTICUT," "DECATUR" AND "SHERMAN"

The model of the "Connecticut" is illustrated in Fig. 1. Only those who have had the opportunity of examining this recently commissioned vessel can appreciate fully the painstaking skill with which the features of the powerful battleship have been reproduced in this nine-foot work of art.

Another fine model of a different type of vessel is represented in Fig. 2. This was also built at the Washington shops, to show the proportions of the speedy torpedo-boat destroyers of the "Decatur" class. The same scale was used as in the case of the 450-foot battleship, this giving the model a length of about five feet.

Of the work produced for the Government by Mr. Boucher in his own shop, no finer examples can be presented than the two specimens illustrated by Figs. 3 and 4, which are, respectively, outboard and

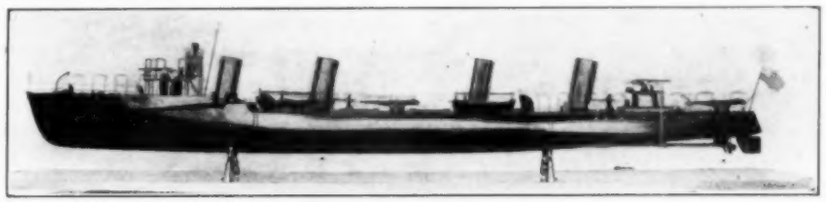


FIG. 2. TORPEDO BOAT DESTROYER MODEL

longitudinal-section models of the twin-screw transport "Sherman."

SECTIONAL MODELS

The length is about 12 feet and in the sectional job there are about 10,000 distinct parts. The "Sherman" is arranged to accommodate nearly 1800 troops and the exposed section contains 900 bunks, which, like a few thousand other parts, are removable. These models and a cross-sectional one now being built at the Boucher shop are to form part of the Government exhibit at the Jamestown Exposition, and will give visitors an excellent idea of the way the great troop ships of the quartermaster's department of the United States army are fitted up. Another interesting piece of work was turned out some time ago at the same shop to show the interior construction and fittings of the vessels of the "Connecticut" class. As this was designed for instruction purposes, the various parts were made on the removable plan, as in the case of the "Sherman."

OTHER INTERESTING WORK

Considerable work is done at this shop for builders of fast launches and motor boats, for yacht clubs and owners, and for companies operating passenger steamers. Thus, Fig. 5 represents a model of the "Hendrick Hudson," the newest and finest of the Hudson river boats. This model, measuring about eight feet in length, was for some time exhibited in a window on lower Broadway, where it attracted much attention from the passing crowds.

Fig. 6 illustrates a small-scale model of the schooner yacht "Endymion," a noted transatlantic racer. A more recent contract executed for the New York Yacht Club comprised a series of 20 ships representing the development of the navy from the time of the "Bon Homme Richard" down to the present day.

Just at present the most interesting work on hand is a model of the Oyster Bay review of last September. This, when completed, will show 45 miniature naval vessels, ranging in length from 2 to 5 inches, arranged in proper order on a 10x20-foot canvas-covered table. This is to form another of the Government exhibits at Jamestown.

SMALL ENGINES

The engine in the sectional model of the "Sherman," Fig. 4, is about six inches high. Two of these were made and the starboard one is shown about one-sixth its actual size in the rear of the group in Fig. 7. This model is made to a scale of ¼ inch to the foot and represents a triple-expansion machine of a few thousand horse-power and is complete in every detail, except that it is not designed to take steam. The simpler engine to the right is a working model which has been used in driving small craft.

OTHER MACHINERY, GUNS, ETC.

The propellers, windlasses, winches, paddle wheel, guns, etc., shown in this engraving are also made to scale from the working drawings and nearly every member of the group constitutes an interesting piece of metal work.

Although the deck machinery—such as winches, capstans, etc.—is not intended to be operated, the gears, drums, and all parts in general are made as accurately as if for working models. The guns may be swung about, elevated and depressed, and adjusted generally in pretty much the same manner as real rifles on board ship. However, as the largest one shown is actually only about four inches long, it is hardly necessary to state that the breech-block mechanism is not intended to be operated.

MATERIALS AND METHODS

At the London Exhibition of 1862, an

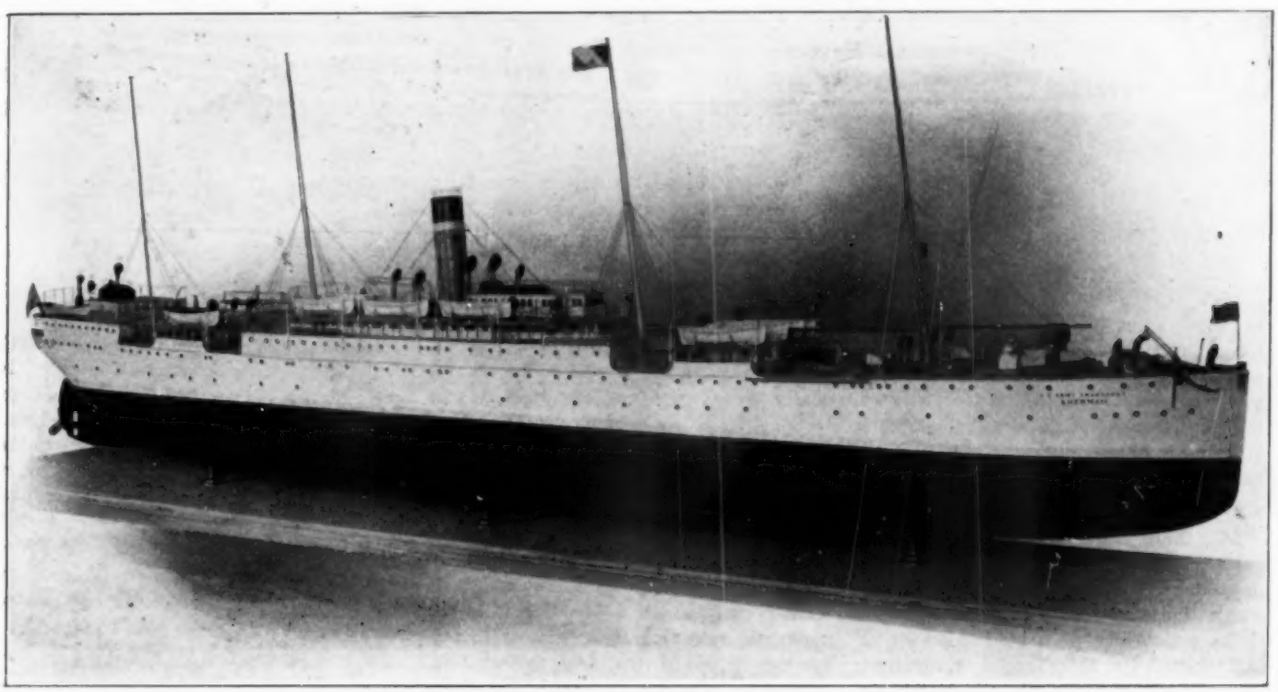


FIG. 3. OUTBOARD MODEL OF U. S. ARMY TRANSPORT "SHERMAN"

ingenious mechanic who had constructed a duplicate of some important feature of the show placed over his exhibit a placard bearing this couplet:

Perseverance, Cork and Glue,
Eighteen Hundred Sixty-two.

It is safe to say that the Boucher models are not turned out without liberal use of two of the above "ingredients;" cork, however, probably finds no place in their construction. The material used in the hulls is white pine, which, after being glued up to the required bulk is shaped to the blue-print dimensions. Necessarily, many of the parts—both wood and metal—which are used in any given model are peculiar to that job and cannot therefore be manufactured in quantities by special tools. As a result there are numerous small machines and fittings to be built up piece by piece by the workman, in much the same manner as he would construct a large piece of machinery of a special nature.

DUPLICATE PARTS

Still there remains quite a number of parts which can be "manufactured" by the up-to-date model-maker. Take for example the hundreds of stanchions on the decks and bridge of a battleship: on an eight-foot model, these would be, say, from an inch to an inch and a half in length and the body about 1/16 inch diameter. For turning out these fancy little uprights, Mr. Boucher has had forming tools made which are used in a Rivett bench lathe, and the parts are produced in lots of a thousand or so, at the rate of seven hundred or eight hundred a day. Formerly these stanchions, like so many other pieces, were filed out by the workman, who would perhaps in this way make only 15 or 20 per day. Such pieces as guns and gun mounts, blocks for yacht models, etc., are also produced to advantage in comparatively small lots by means of simple and special tools.

COST OF MODELS

A few figures showing the cost of some of the work illustrated may be of interest. The battleship model, Fig. 1, was built at an expense of $3300; the two transport models, Figs. 3 and 4, cost the purchaser nearly $7500, the engine fitted to the sectional model alone being valued at $300.

The amount received for the "Henárick Hudson," of Fig. 5, was in the neighborhood of $3500. F. A. S.

It is reported in a press despatch that the German government is re-arming its infantry with a new rifle which is of the automatic reloading type; that is to say, by the recoil of the arm the shell is ejected and the arm is reloaded, ready to be fired again.

Building a Large Crank-shaft—Some of the Methods Employed

BY W. BURNS

The machining and building up of the various parts of a large marine engine crank-shaft is a work requiring much skill and time for its successful accomplishment. A short description of the tools and methods employed may be of interest. Take the case of a three-throw continuous built-up crank, the shaft diameter being 8 or 9 inches, this being a very common size of shaft.

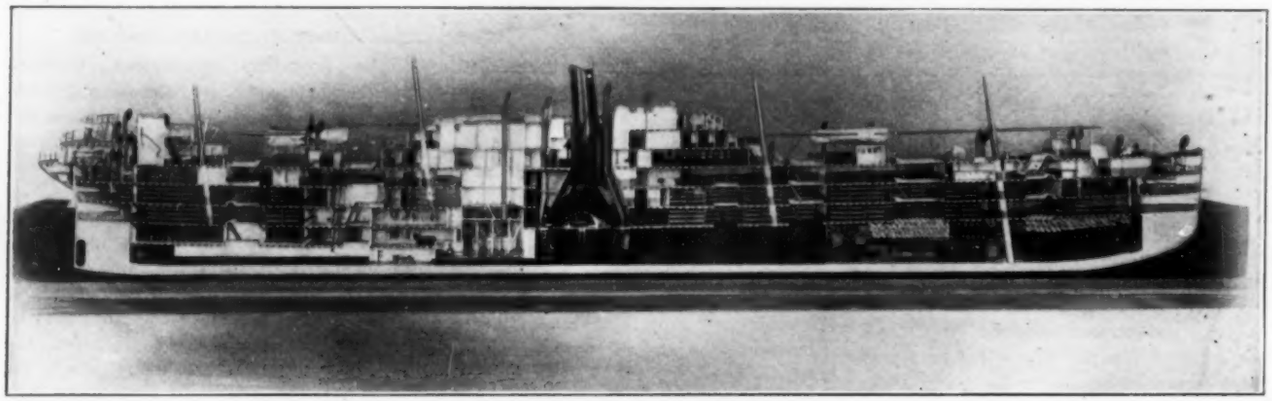


FIG. 4. SECTIONAL MODEL OF THE "SHERMAN"

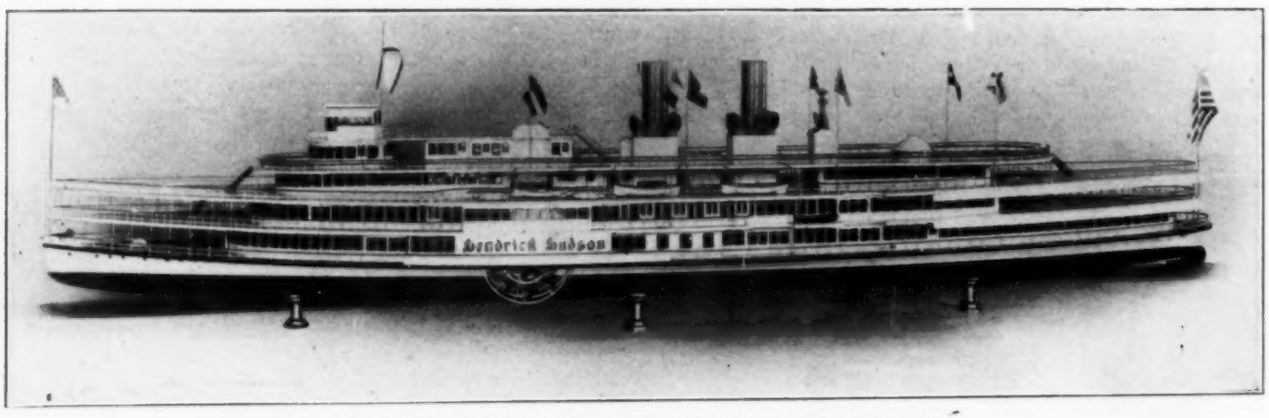


FIG. 5. MODEL OF THE HUDSON RIVER STEAMER "HENDRICK HUDSON"

PROCEDURE WITH THE LARGER SIZES

In the larger sizes the cranks are usually built up separately, and connected in their proper sequence by solid couplings forged on the shaft ends. This is advisable in the larger sizes, as it facilitates the construction of the crank, it being much easier to build up three separate cranks, coupling them together when finished, than to shrink all the different cranks together, then turn the job up; further, it has the advantage that should any flaw or break develop in one of the cranks, it is readily disconnected for repair or replacement. Obviously the forging and turning of two couplings for each separate crank

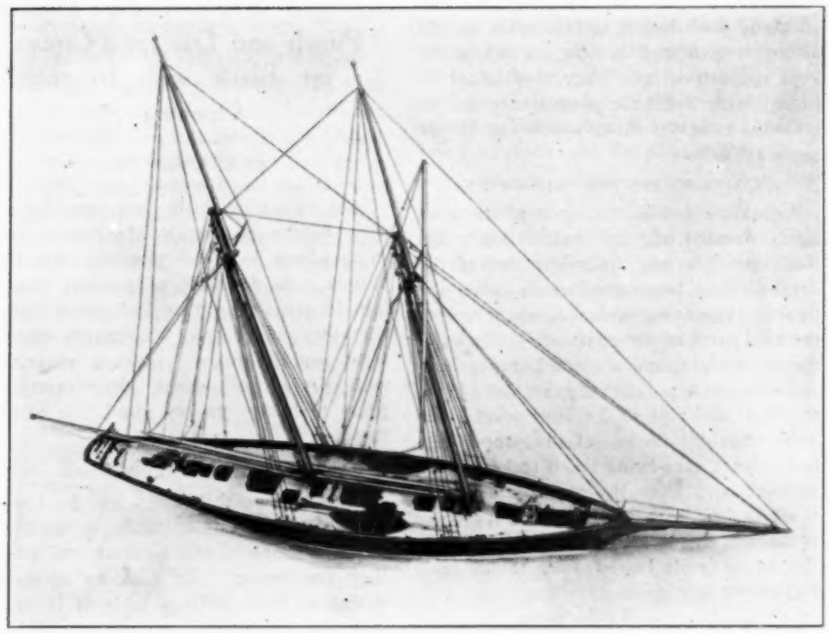


FIG. 6. MODEL OF YACHT "ENDYMION"

involve a great deal more work, and this method is not much used in the smaller and cheaper classes of shafts.

MACHINING THE WEBS

For a three-throw crank there are, of course, six webs. The first operation is the planing or milling of the sides parallel, and to a given size. The forgings for the webs are solid slabs of iron as no attempt is made to rough out the holes for the pins and shaft when forging; the outside edges are dressed off roughly to size, allowing for machining. After the sides are faced up, the webs are marked off for the pin and shaft holes, and for the machining of the edges. One only of each pair of webs is marked off, the boring out of the holes and the machining of the edges being done with the webs placed in pairs to insure that when the pins and shafts are shrunk in, the holes will exactly coincid ; were this not so, the shaft, when shrunk all together might be found very much out of truth.

DIFFERENT METHODS FOR LARGE AND SMALL WEBS

While in the larger sizes it is expedient to take the machining of each pair of webs separately, as they are thus more easily handled, and machined, the smaller sizes may be bored out and the edges slotted with all the webs placed together, and some time economized. Were all the larger-sized webs placed together, however, there would be some difficulty in boring out such a long hole exactly parallel; further, there is no advantage to be gained by machining them at one time.

BORING FOR THE SHAFTS AND PINS

The procedure in boring out is first to drill, say a 1½- or 2-inch hole through the webs, on a suitable radial drill; they are then taken to a powerful upright boring machine, and the holes bored out with an opening drill to 4 or 5 inches diameter. After this a heavy boring bar is used to enlarge the hole to the given size. Both holes are first roughed out to within about ⅛ inch of finished size, then one is finished to size, a temporary pin fitted in lightly to keep the webs in position, and the other holes finished. A plug is often fitted in both holes to keep the webs in position while slotting the edges.

FINISHING PREPARATORY TO PUTTING TOGETHER

This finishes the machining of the webs; they are then carefully marked for the position in which they have been machined, and passed to the turner for fitting the pins and shaft. The pins are finished to size and length, then marked for position. Usually the pin is parallel, the body being the same diameter as the ends in the webs.

The different parts of the shaft are now finished at the ends to fit the webs, and to their proper length; the body, however, is left rough, ¼ to ⅜ inch being left on for turning when the shaft is shrunk together. This finishes the work of the machinist for the time, and the shaft is now passed on to the erecting shop to be built up.

OPERATIONS IN THE ERECTING SHOP

First the shaft, webs and pins are laid out in position, and all sizes tested; these found correct, all sharp edges and burs are removed with a file, then the shaft is ready for shrinking.

All parts of the shaft are shrunk into the webs before the pins are touched; this permits the easy drilling and fitting of the

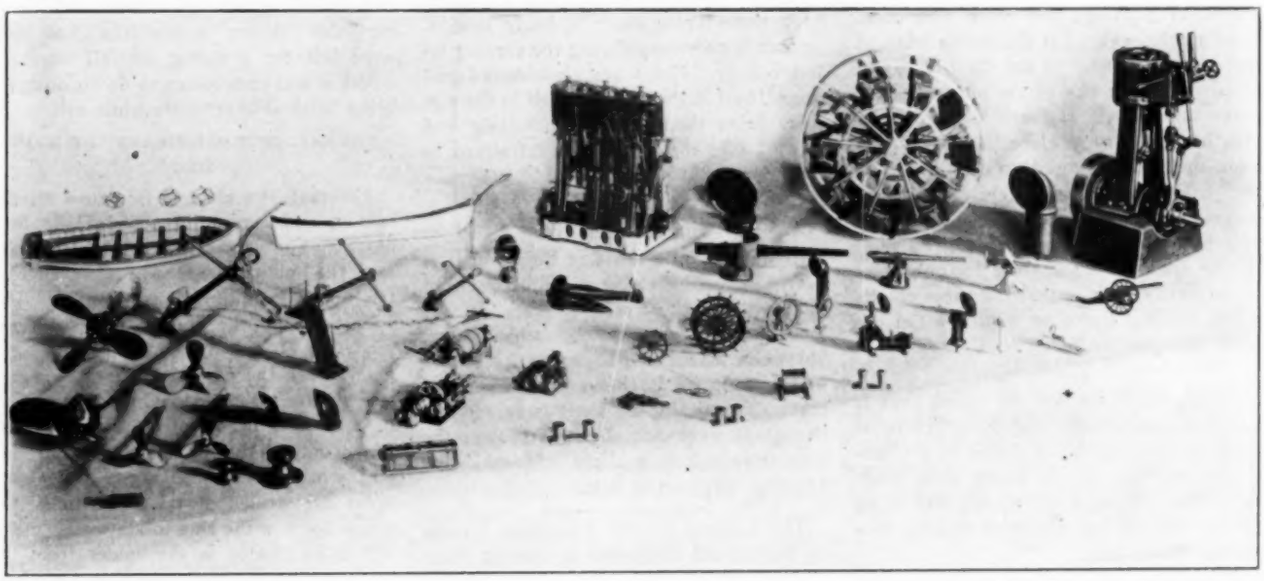


FIG. 7. PARTS OF SHIP MODELS

round keys which act as a safeguard to prevent the webs turning on the shaft.

The heating of the webs may be done by means of a cylindrical gas or oil burner placed inside the hole in the web, and supplied with air pressure, asbestos sheets or plates being placed at each side of the hole to keep in the heat.

SHRINKING THE WEB ON ITS SHAFT

The most convenient way is to place the web to be heated on parallel slips, and, while the bunsen burner is heating, to suspend the shaft for the web on the crane, keeping it as nearly vertical as possible; then, when the hole is expanded sufficiently, this being gaged by calipers, the shaft may be dropped in and left till the web has caught.

This is all right for the two outside end webs, and one web on each of the center shafts, but in putting on the other two webs care has to be exercised, as the one crank-pin must be 120 degrees around from the other.

LOCATING THE CRANKS AT THE PROPER ANGLE

A very practical way of securing this result is to set up the shaft with the web already shrunk on one end, and, getting the center line of the crank-pin and shaft, mark it on the shaft where the other web is to be placed. Now by dividing the circumference of the shaft into three parts we get a line which locates the other crank for position. The dividing of the shaft is very easily done if a small steel tape is available. It is only necessary to put the tape round the shaft, note the number of inches, divide by three and you get the location of the crank center line. Of course, it is necessary to measure very exactly.

THE LOCATING LINES

With a sharp flat chisel make a light mark on the rough part of the shaft, along the line, and make it close to the edge of the finished part, so that when the shaft is placed in position this mark will come close to the web. On the inside edge of the web, at the edge of the shaft hole, and along the center line of the pin and shaft, make another chisel mark. It will now only be necessary to place the web on the slips, then, when heated, to drop the shaft into position, setting the chisel marks to correspond, and the web will be in its correct position. The same procedure applies to the other crank and shaft; the only point to be watched for is that the three cranks when finished make an angle of 120 degrees with each other.

KEYING

Boring the holes for the round keys is the next operation. Sometimes there is only one key, this being placed in the center of the web; in the larger sizes, however, two are more common, these being spaced a short distance apart on each side of the center line.

Round keys of the best mild steel are now turned a very tight driving fit for the holes, and a deep and narrow groove cut all along their length to insure the escape of any imprisoned air or oil, when the keys are driven up. They may either be forced in by hydraulic pressure, or driven in with a heavy ram, whichever is the more available.

SETTING UP FOR THE CRANK-PINS

This done and all the ends of the keys nicely dressed off, the shaft is ready for the pins. Starting from one end of the shaft—it does not matter which—place the two corresponding webs together, resting the two parts of the shaft on V blocks of the same hight, and the crank-pin ends of the webs on a parallel slip, so as to bring the shaft and pins to the same level. The webs should now be set the proper distance apart, care being taken to keep them parallel, and have the two parts of the shaft in line with each other. When all is accurately set, the shaft and webs should be firmly bolted down to the table to prevent any shifting.

ANOTHER SHRINKING OPERATION

The bunsen burners can now be applied to both webs, and, when the holes are sufficiently expanded, the pin slipped into place, everything being left fixed till the pin is firmly held in the webs. It is best to give the metal around the pin holes enough heat to provide a good clearance, as the pin has to be passed through one of the holes, cooling it slightly, and, should it chance to catch, great trouble would be experienced in removing it. The rest of the shaft should now be treated in the same way, then it is ready for turning.

LATHE WORK

Distance pieces to take the thrust of the lathe centers are fitted between the webs, and the shaft put in the lathe. If the machining of the crank webs has been accurately done, and the shaft carefully set up when shrinking in the pins, it will be found to rotate very little out of truth. As a three-throw shaft is fairly long, a support is necessary during the turning up of the body. Holes are also bored and tapped, half in the web and half in the pin, plugs being then screwed in tightly and dressed off; these act as a safeguard to keep the pin in position, should it by any chance become slack.

THE FINISHED JOB

In turning up a shaft of this kind it is nearly impossible to get it dead true, even though the greatest care is taken. It may look all right when on the lathe centers, but when placed in position in its bushes in the bedplate it shows a little out of truth. Practically the shaft is as good as though it were not slightly sprung; the only drawback is a slight stiffness when rotating the shaft at first.

The address of the American Society of Mechanical Engineers is now 29 West Thirty-ninth street, New York, instead of 12 West Thirty-first street.

Sectional Press Tools—Built-up Punch and Die for a Circular Blank with Irregular Opening.

BY R. A. ALMOND

It is now some little time since I have seen in the AMERICAN MACHINIST anything about sectional punches and dies. Where it is desirable to produce punchings in great quantities, and also essential that they be accurate as regards dimensions and in many instances reversible with perfect alinement, these sectional press tools are, to my mind, the proper thing.

DESIGNING SECTIONAL DIES

In presenting this punch and die I wish particularly to call attention to the number and shape of the sections into which they are divided. In deciding upon the design of such built-up tools, it is desirable that we consider the possible effect of the hardening process and the consequent warping of the different sections, and lay out the divisions with a view to avoiding trouble in this respect; then, too, when assembled, each individual section of the punch and die must be solidly supported in position, and at the same time the construction should be as simple as possible to lessen expense, which is always an important factor, particularly from the proprietor's standpoint.

THE WORK AND THE PUNCH

The punchings from this set of tools are from sheet steel 0.014 inch thick, and in shape as shown in Fig. 1. Fig. 2 shows plan, longitudinal section and details of the punch, and Fig. 3 a plan, section and details of the die. In Fig. 2 the punch proper is shown built up in twelve sections. After making the necessary templets the various parts were shaped up and drilled for screws, dowels and bushing holes. A few thousandths of an inch were left for grinding on all surfaces where it was convenient to do so, the rest being finished to templets while soft.

THE CAST-IRON HOLDER AND THE MAIN RING

The cast-iron plate *A* is planed on the bottom and across the tops of the four bosses. The center is bored and reamed to fit the hub of part *B*, and is recessed on the upper face to receive ring *C*. The four holes in the corners for sub-press pins like *D* are drilled and reamed together with the die block after the punch and die are assembled. Outside ring *C* is of tool steel hardened in fish oil and drawn only till the strain is off; it is ground on the inside to receive ring *E*. One-eighth holes are drilled at the bottom of the screw holes in the ring to allow that member to be located in the holder from the top when assembling. The dowel-pin hole is counterbored down half its depth, as

a long dowel pin will warp in the hardening and change its position in the ring.

CONSTRUCTION OF THE PUNCH PROPER

Part *B* is made of tool steel; the hole in the center is merely for a mandrel used while working the piece into shape. After it is put into place in block *A* two holes are drilled and tapped from the bottom for ⅜-inch 16-thread fillister-head screws, half of each hole being in the holder and the other half in *B*. There are four sections *F* made of tool steel, hardened and ground on the cutting edges; two screws and two dowel pins keep each section in position in a dovetail slot in *B*. In one side of each piece *F* is cut a narrow dovetail slot with a taper from the bottom, and a piece of tool steel *G*, hardened and ground to ½-degree taper, is drawn into place from the back side.

THE PIERCING PUNCHES, EJECTOR, ETC.

Four pieces *H*, also of tool steel and hardened and ground on the cutting face, are each held with one screw and two dowel pins in the plate *I* and act as knock-out plugs. Plate *I* is of machine steel, case-hardened, and fits freely in place. Tool-steel ring *E* is hardened, ground on the outside to a sliding fit in ring *C*, and held in position on the plate with two dowel pins. The piercing punches *J* are a sliding fit in holes formed in this ring. These are merely 0.201-inch wire, headed over on the bottom, and backed up with screws tapped into the bottom of the cast-iron body. After hardening, the punches are lapped straight to finish size. Twenty spiral springs *K* are placed under plate *I* to throw out the punching.

THE DIE CONSTRUCTION

The construction of the die proper is clearly shown in Fig. 3. After making the necessary templets the various sections were shaped up and drilled for screws, dowels, and punch holes, a few thousandths of an inch being left on all surfaces where possible to finish by grinding, the rest being finished to templets with the file. After the hardening and grinding operations the parts were fastened by screws and dowels to the plate *L* for convenient handling in the further operations required to make the whole conform to the templet.

THE DIE BODY AND PRINCIPAL MEMBERS

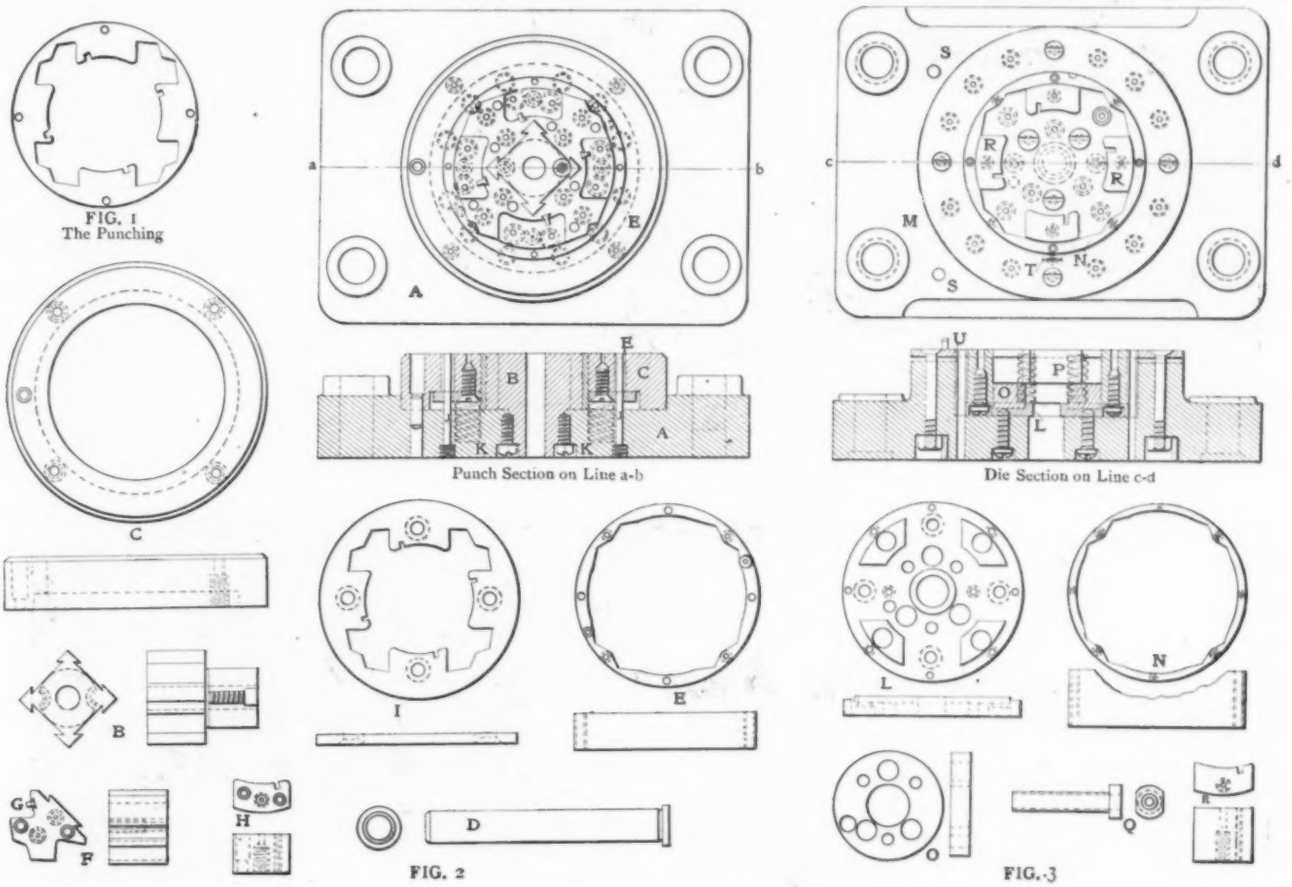
The casting *M* is planed on the bottom and across the tops of the four bosses, the center being bored to make a snug fit for ring *N*. At the bottom of the recess is fastened the disk *L*, made of machine steel and case-hardened. It is held with two screws and three dowel pins. On the top rests a cast-iron ring *O*, which is held in position with three dowel pins; the other three holes are made to seat the three stripper pins *P*. The outside of disk *L* fits the tool-steel ring *N*, after it is bored and shaped to fit the templets. Four tapped holes receive screws which keep the ring in position, and there are four straight holes in the disk to fit the four bushings *Q*.

PIERCING-PUNCH HOLES, ETC.

After the disk is hardened the outside is ground to a driving fit in the cast-iron holder, and after all parts are assembled the piercing holes are located with a transfer plug from the punch holes proper, while the bushings *Q* are soft. The bushings are then drilled, reamed and clearance reamed from the back with a reamer tapered ⅛ inch to the foot. Four blocks *R*, made of tool steel and hardened, are held to the plate *L* with one screw each.

GUIDE AND SUB-PRESS PINS

Two guide pins *S* are driven into the top of the cast-iron holder *M*, and a guide pin *T* located 1/16 inch from the cutting edge. The four sub-press pins *D*, Fig. 2, are of tool steel, hardened as far as the head, ground to a driving fit on the head end, and at the other end to a sliding fit in the punch holder *A*. To locate the holes for these plugs, to bring them in line with each other, and at the same time square with the punch and die, after the



SECTIONAL PRESS TOOLS

punch and die parts were hardened and put together two parallels were placed between the castings, the punch placed inside the die, and the two clamped together with four *C* clamps. Matching the work in this way the holes, when bored, were bound to come in alinement.

THE STRIPPER

The stripper *U*, Fig. 3, is of machine steel, and shaped to fit the cutting edges of the punch and die closely. It is held with four flat-head screws, and there are 12 spiral springs under it. The inside stripper is made in the same way with three screws to hold it in place, and seven operating springs beneath.

The Imaginary Evils of the New Things

A certain Somerset vicar made himself notorious by the vigor with which, in the seventeenth century, he inveighed against the use of the newly invented optic glasses, since they perverted vision and made all things appear in an unnatural and therefore a false light. Microscopes and telescopes, with their array of lenses, he declared to be impostors, since a man could not see so well with two pair of spectacles as with one. Some asserted it to be sinful to assist the eyes, which were adapted by Providence to the capacity of the individual, whether good, bad or indifferent. "It was argued that society at large would become demoralized by the use of spectacles; they would give one man an unfair advantage over his fellow, and every man an unfair advantage over every woman, who could not be expected on esthetic and intellectual grounds to adopt the practice."—*Spectator.*

A PATTERN-MAKER'S IRON TABLE—A MOVABLE GLUE PRESS

EDITORIAL CORRESPONDENCE

Why a patternmaker's iron table? Why a machinists laying-out table? After seeing a patternmaker's table in use the question most men would ask would be why it did not come before, instead of after, the laying-out table.

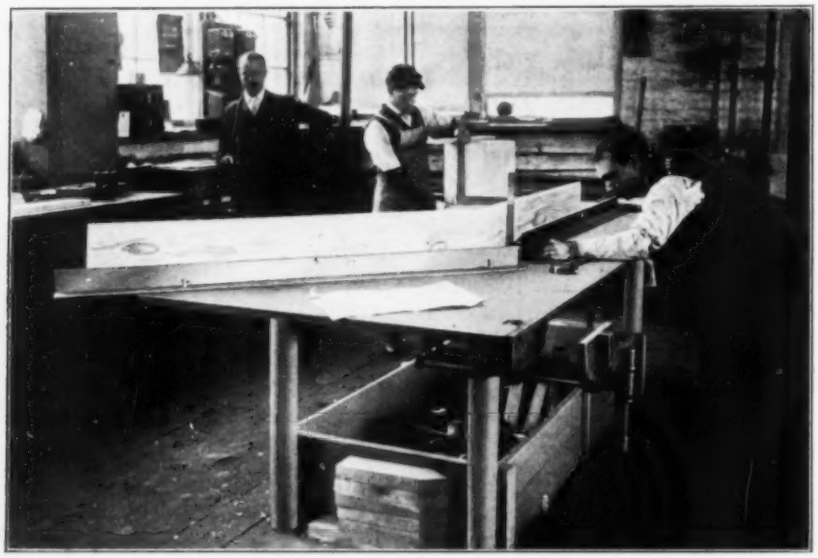


FIG. 1. A PATTERNMAKER'S IRON TABLE

An iron table does not appear in a photograph as essentially different from a wood bench. It has a flat surface and its edges are straight and square with one another. These features do not show conspicuously in a half-tone, and at first sight the convenience of such a table is not apparent; but a little use brings them to the front.

Several months ago Robert Wyatt, foreman patternmaker of the Canadian Rand Drill Company, Sherbrooke, P. Q., became convinced of the usefulness of a table of this kind, and had one made 3x6 feet in size. As the men began to realize its usefulness they became constant candidates for places around it, and the pressure soon became so heavy as to make necessary a second table, which was made of larger size, 4x10 feet. Both are in constant use, and the shop would scarcely know how to get along without them.

USES OF THE TABLE

The illustrations show the larger table with a variety of pieces of work in progress. It is a simple table surfaced true and with square edges, its only attachments being a Toles' vise at one corner, and some light angle irons planed to a true surface, with a series of dowel pins and holes by which the angles may be placed on the table in various locations and parallel with one edge, or at angles of 30, 45 and 60 degrees therewith. In Fig. 1 the workman is at work on a pattern of which the two pieces are to be at an angle of 45 degrees with each other. With the angles doweled in place, the pieces may be nailed or glued to a base piece with scarcely a possibility of being wrong, while the operation of squaring up from the table is equally certain.

FIG. 2. A PATTERNMAKER'S IRON TABLE

The convenience of the vise to the

workman is obvious, as he may do his work without going to his bench. In the background of this view is a large pulley-hub pattern, on which the workman is erecting a perpendicular from a given line.

In Fig. 2 a large core box is being built up by means of forms. The forms must be square with the center line of the box and parallel with each other, all of which is secured by sliding the angle iron back to suit the size of the box and placing the edges of the forms against it, when, by the application of the square, the forms are at once brought to correct position, and the segments may be glued with the certainty that the result will be correct.

FIG. 3. A PATTERNMAKER'S IRON TABLE

Fig. 3 shows a number of jobs. In the right foreground the arms for a pulley pattern are being put together, while in the center at the left a fly-wheel segment pattern is being built up. On the opposite side of the table a compressor-frame pattern is being tested for squareness, and at the further end a surface gage is in use.

Fig. 4 shows a large pattern in process of gluing up, the angle irons again coming into use and the convenience of the vise being especially obvious, as is the usefulness of the flat surface of the table, in detecting any imperfection in the joints.

In general, the table does away with all temporary fixtures and provides a permanent flat surface on which to build up patterns. The construction is of the simplest, the legs being of pipe secured in hubs cast on the underside of the table.

A MOVABLE GLUE PRESS

Another of Mr. Wyatt's ideas is a movable glue press shown in Fig. 5. Four horses have jack screws at one end, and movable stops which may be placed at any point of the rail. The operation is obvious, except that it may be worth while to say that, not being attached to the floor, the horses adjust themselves to the work as the screws are tightened. In addition to such jobs as the one shown, the press is used to glue up waste pieces as they accumulate, and thus a constant supply of such material is kept on hand.

F. A. H.

A Chat about Clocks

BY D. G.

There is a good deal of uncertainty concerning the origin of clocks. The ancients evidently judged the time from the movement of the heavenly bodies, for we read of events taking place "between the rising of the sun and the going down thereof." Sometimes dates were reckoned by being so many moons apart, and so on. Statements have been made by many writers that some form of clockwork existed in the ninth century A.D., but there is no proof to show that they in any way resembled clocks as we now know them. Many allusions have been made to "horologia" by twelfth-century writers, but it is not till the thirteenth century that we find infallible proof of clockwork existing.

A clock was sent by the Sultan of Egypt to the Emperor Frederick II in 1232. A description of it is as follows: "It resembled a celestial globe, in which the sun, moon and planets moved, being impelled by weights and wheels, so that they pointed out the hour, day and night with certainty." What the ultimate fate of this clock was, no one knows. In 1288 a clock with great bells was placed in the then existing tower of Westminster Abbey, London, the cost being paid out of a fine imposed upon a corrupt chief justice.

What a world of bells we should be living in at present, if a similar fine were imposed upon every corrupt chief justice in the land! What a glorious time for architects designing clock towers! The towers and minarets of Eastern cities would pale into insignificance. But the infernal noise—just think of it! After all, it might be a blessing in disguise, for the intolerable row would cause people so much annoyance that they would insist upon having honest justices elected.

But to return to our ancient timepieces.

FIG. 4. A PATTERNMAKER'S IRON TABLE

There was one from Dover Castle, England, exhibited at the Scientific Exhibition of 1876, which bore the date of 1348, and was still working at the time of the exhibition. This clock had works very similar to our grandfather or "colonial" clocks, with the exception that it had a vibrating pendulum. A clock very much the same as this was made about that time by De Vick, for the French King Charles V, and this also had a vibrating pendulum.

The pendulum with the spring on the top end, such as is now universally used, was not invented till about three centuries later. The claim to the invention of the pendulum, like many another invention, is disputed. Some attribute it to Galileo, some to his son, others to Huyghens, Dr. Hooke, and a London clockmaker named Harris. In any case, it was the beginning of the seventeenth century, when the pendulum as we now know it was first used.

Scattered through Belgium and Holland are still to be found tower clocks of the fourteenth century—if the dates on them are correct. These clocks have only one hand, pointing out the hours alone, and generally striking the hours and half hours. In those far-off days there was none of the modern feverish rush and hurry. A few minutes either way didn't matter much. Anywhere between the hour and the next half hour was near enough for the good folk of that time.

Most of the faces of these tower clocks were made of stone, painted black, with the hand and figures gilded. That their works were well designed is beyond doubt. The excellent time that they keep testifies to that. For centuries both tower and house clocks were made of a design similar to those of the fourteenth century, the principal difference being the additional wheels required for the minute, and, later on, for the second hands. The invention of the minute hand dates about 1680.

Some dials, such as are still to be seen on the towers of the cathedrals in Bruges, Mechlin, and Antwerp, were of a skeleton formation gilded over, and showed the masonry of the towers behind them. On such faces it is comparatively difficult to see the time, especially at a distance. The clocks in the Antwerp and Mechlin towers are of a more recent date than the fourteenth century. The one in Mechlin, if I mistake not, was made in the early part of the sixteenth century, and has only one hand. The works are principally made of forged iron, richly ornamented by hand. The dial of the clock is, or was until quite recently, the largest in the world, being 40 feet diameter. The Antwerp clock was made in the end of the eighteenth century, and is therefore a comparative youngster. Both these clocks, and also the one in Bruges, have fine carillons, and their quaint, old-world mellow chimes are very pleasant to hear.

I have several old house clocks in my possession. One, which has been judged by experts to have been made about the end of the fourteenth century, has one hand only, strikes the hours and half hours, and has only one chain and weight, the chain passing round the barrels for both the striking and time mechanism. It has a vibrating pendulum. The face is an iron plate, on which a landscape has at one time been painted, and riveted to the top and sides of the face are ornamental lead castings, gilded over so as to give the face the appearance of a small framed painting. The small brass pillars, which form the supports for the works, are ornamented. Another clock of the same kind bears the date of 1547, but has two hands and a vibrating pendulum, and also an alarm arrangement with a small hammer, which strikes the bell from the inside. Whether this and the minute hand belonged to the clock originally, or have been added since, is doubtful. Alarms on colonial clocks have existed for centuries, as I have had four of them in my possession with alarm attachments, one of them a seventeenth-century clock.

FIG. 5. A MOVABLE GLUE PRESS

There is a house clock at present in Flanders, Belgium, which has a sort of tin dial with one hand, bearing a fifteenth-century date. It runs 24 hours, and the weight is pulled up by a small rope much like an ordinary clothes-line. Needless to say, the owners won't part with it.

Many of the early house clocks were made entirely of wood, works, face and hands, very probably for the sake of cheapness. Some of them are still extant and working. They were generally made of oak, and in some cases the wheels had brass pins driven into them to form the teeth.

Coming to the grandfather clocks, we find a great similarity in the construction of the works for hundreds of years. In many cases "extras" were added, such as a revolving plate with sun, moon and stars painted on it, moving round through an opening in the top part of the face. Although the sun, moon and stars plate appears to have been the most common, there were many other devices made to work in connection with the clock, such as ships, landscapes, windmills, water wheels, Neptune with his trident, and others. In some instances a special mechanism showed the date and name of the month, and also the day of the week.

Some of these clocks had a musical attachment, which played old-world airs just before the hour was struck. The ordinary clock chimed only the hours, on one bell; others chimed the hours and half hours on two bells, while the more expensive ones chimed the hours, half hours and quarters on three bells.

The dials were generally made of brass, although not a few were painted. Those belonging to the seventeenth and early eighteenth centuries were ornamented with brass figures at the four corners, and sometimes had a brass ball or disk on top, on which the maker's name and occasionally the date were engraved. A separate ring of pewter or brass, on which the hours and minutes were engraved, was fixed to the dial. In some cases a long second hand, stretching right across the face, took the place of the ordinary small second hand. Clocks with this long second hand and sun, moon and stars, are now very scarce, and are much sought after by antique dealers. There is one in Antwerp which has a carillon of twelve bells, besides bells for the hours, half hours, and quarters; has sun, moon and stars movement, an ornamented brass face, and a long second hand reaching right across the face like the second hand on a

stop watch. Naturally, the owners won't sell it, although the case is falling to pieces. Toward the middle of the eighteenth century, plainer dials were used, generally a simple brass plate on which the hours and minutes were engraved. Then about the end of the eighteenth century and beginning of the nineteenth, the ordinary enameled face came into vogue, so that clocks with enameled faces are rarely more than 130 years old.

The clock cases were generally made of oak or mahogany, although many of the cheaper ones were made of commoner woods and painted. Opinion is divided as to whether oak or mahogany was the better wood for cases. Mahogany ones appear to have lasted longer than oak, but this may be due to their having been looked after better, as only the fairly well to do people could afford mahogany. Comparatively few old oak cases are to be found in good condition, the lower part of the case being generally in a state of collapse. No doubt this has been caused to a great extent by their having been placed on earthen floors. I have one clock with a carved oak case in splendid condition, with a massive carved top piece, and it stands quite ten feet high. It is made of oak which has been specially treated, and is called watered oak. The oak was first laid in water for a period of years, and when taken out was placed in a room where it was smoked for another period. In some parts of Belgium the planks were hung in the chimney for the smoking process. The combined effect of water and smoke has given it a beautiful dark brown color. Oak so treated formerly was much used for making furniture.

Scattered throughout the more northerly States of America are to be found clocks with wooden works and faces. They are not always so old as one might expect, as many such were made after the War of Independence. After the war, money was scarce, and people weren't able to pay for brass works and faces, hence wood was substituted. In Concord one maker alone made over 160 clocks with wooden works and faces. No doubt they kept good time, and are well worth preserving.

Another class of clock which had quite a spell of popular favor was the Dutch "wag at the wall." These generally had glass dials, and the pendulum and weights were exposed to view at all times, as they had no cases, such as the colonial clocks had. The frames of the works were made of wood, but the wheels and arbors were made of brass and iron respectively. They were cheaply got up, and kept fairly good time, and no doubt helped very materially to lessen the demand for the more expensive colonial clock.

When one comes to the cheap modern clock, with its nerve-racking clackety-clack and raucous gong, one is inclined to say: "Oh, what a falling off was there!" Couldn't the grandfather clock be introduced again with advantage? With modern machinery it could be made cheaper, and more accurate even, than in the days of our forefathers. Ornamented machine-made cases could be turned out at a much smaller figure than the old hand-carved ones. There is always something soothing and restful about a colonial clock. Its slow and solemn tick-tock, and its gentle purring whirr before it chimes, are much more pleasant to listen to than the noisy click-clack of the modern alarm. Such a clock—not the alarm by any means—rarely gets out of order. With an occasional overhaul it is good for generations. Those who are the happy possessors of such clocks should treasure them, if only for past associations' sake, so that when they—the people, not the clocks—shuffle off this mortal coil, they—the clocks, this time—may be handed down as heirlooms to the next generation.

Escalators Which Will Break the Record for Size

The New York and Long Island Railway Company, known as the Belmont or old Steinway Tunnel system, has just awarded a contract to the Otis Elevator Company for the two largest escalators ever built, to be installed in the Manhattan terminal of that system at Forty-second street, between Lexington and Third avenues. Trolley cars instead of trains are to be operated in this tunnel, and they will run on short headway providing a tremendous capacity, which, it is estimated, will be at least equal to that of the trains of the present Brooklyn Bridge during rush hours; the escalator equipment, above referred to, will be equal in point of capacity to that of the entire stairway equipment of the Manhattan end of the Brooklyn Bridge. Furthermore, not only will the escalators be sufficient to handle any number of people up to the capacity of the trolley cars of the tunnel, but they will also serve to marshal the crowds into streams of people moving uninterruptedly and not coming into conflict with one another. The escalators will provide service between levels something over 55 feet apart, and will be arranged side by side. Most of the time one will be operated ascending and the other descending, but during the morning rush hour both will be operated ascending.

As an appropriation has already been made for a new Manhattan terminal to the Brooklyn Bridge, to be located underground, it will be interesting to note whether this municipally owned enterprise will be as progressive as the privately owned one in the matter of installing moving stairways.

The escalators, in common with the entire terminal, possess no woodwork or other inflammable material. As is well known, the escalator is the invention of Charles D. Seeberger, who is now head of that department of the Otis Elevator Company.

In connection with these tunnels, it may be interesting to mention that the chief engineer of the board of estimates is reported to have found that the shields in the north tube under the East river still lack 600 feet of meeting, and the south tube shields are 750 feet apart. This failure to finish the work by January 1, as provided in the old Steinway grant, has resulted in the raising of a legal question as to the status of the franchise rights.

Newman's Kinematic Apparatus for the Study of Mechanism

The designing engineer or draftsman who has had experience in making skeleton diagrams of more or less complicated mechanisms, getting his paper covered with a network of lines that represent the various elements in different positions, and that take a lot of time to lay out and are difficult to decipher in spite of a key system of full and dotted, dot-and-dash, black, red, blue and green lines, and then, perhaps, finding that some change is necessary, and the work must all be done over again, will surely appreciate an apparatus described in the December 28, 1906, issue of *Engineering* (London), provided it does all that it undertakes. Besides being useful to practical designers, it should be of great value to students in gaining a comprehension of the action of any mechanism, not always easy to grasp from a text-book description, and it will readily show the effect of alterations in the proportions, the curve traced by any given point on a link, etc. The apparatus, consisting of a lot of standard parts, permits of quickly constructing, or rather setting up, a working model of nearly all kinds of plane mechanisms, such as valve gears, straight line motions, cam mechanisms (the cams being cut from heavy mill board, which may sometimes be done by this apparatus), etc.; the proportions are readily changed; and any of the working parts can be made to draw curves of their motions on paper. The apparatus is best used on a table consisting of two drawing boards separated by a narrow slot in which blocks an slide or be clamped, and which may be spanned by bridge tubes in any desired position, upon which blocks may be clamped anywhere to afford fulcrums or supports. The elementary parts are comparatively simple, and include standard flat steel rods and standard pins, of various lengths, standard racks, gears, clamps, pulleys, connecting pieces, etc. The apparatus is made by W. H. Newman, of Totteridge Park, Herts, England.

The fire-proofing of ferry boats, sound steamers and similar craft, so as to prevent the spread of fire, is pronounced feasible by the Naval Architects and Marine Engineers.

OUR MILITARY AND MECHANICAL ENGINEER: THE ARTILLERYMAN*

Have We Enough of His Kind?

BY MARK L. IRELAND

The purpose of this paper is to introduce to the society our military mechanical and electrical engineer—the artilleryman—to show something of the method of producing him, the conditions under which he works, the number on hand, the possibilities of increasing this number to meet a sudden emergency, and finally to invite discussion upon the sufficiency of the peace strength.

As opportunity to see the appliances and weapons with which he fights will be afforded the membership by the trip to Sandy Hook proving ground, N. J., and to Fort Hancock, N. J., during the annual meeting of the society early in December, this paper will be confined to the personnel of our coast and field artillery to the exclusion of the material.

On Sandy Hook, a long peninsula forming the eastern boundary of lower New York bay, will be seen the plant of the Ordnance Department of the army, for the proof of all forms of ordnance supplies pertaining to the weapons of the artillery branch. Contiguous to the Sandy Hook proving ground is Fort Hancock, a modern coast-defense fortress. During your visit we propose to show you the material in the process of development and in service. If you observe the officers and men, you may see something of the personnel of our coast defense: of our field artillery we can show you only the material.

REQUIREMENTS OF AN ARTILLERYMAN

The aspirant for an artillery commission must have acquired a good working knowledge of mathematics, chemistry, optics, surveying, electricity, and mechanics. The successful man finds that this is not only requisite for obtaining his commission, but that his duties from the first are of such a nature that this knowledge is assumed. He must be ready to undertake any task from that of counsel for a prisoner before a court-martial to that of mounting his own guns and breaking in raw recruits for annual target practice. He must be able to tell how a rear guard should defend a retreating army or why a particular generator fails to excite or a gas engine refuses to start.

No matter whether he came from West Point, from the ranks, or from civil life, every artillery officer is destined sooner or later for the Artillery School at Fort Monroe, Virginia for the School of Submarine Defense at Fort Totten, New York, or for the Cavalry and Light Artillery School at Fort Riley, Kansas.

While he is not attending one of these schools, he finds himself occupied with the officers' technical school on technical subjects pertaining to his duties. Failure in any subject means that this will be laid up against him until he clears himself on his next examination for promotion. Failure on examination for promotion means suspension from promotion for a year, while a second failure brings his discharge from the service.

THE DUTIES NOT EASY

We have heard of days when the army officer was so little troubled by his duties that he found life really quite monotonous, but to the youngster, at least, in the service today this is but a tradition, which, strange to say, he hears oftener from his civilian friends than from his superiors. The army today, with its schools, its examinations, its practice marches, and manœuvers, is not the comfortable place it has been supposed to be by some not over industrious youths, whom the exactions of business worried into trying the fabled soft snap. Such a man finds that his duties require his undivided attention for from ten to twelve hours per day, and that, unless he gives them that attention, his superiors soon find a way for him to step down and out, to make way for the man who will.

The enlisted man, who comes to us in times of peace, has little or no experience that is of value to him in his new life. It is a matter of no small wonder sometimes, how a man of his ability could be induced to accept such small pay as $13 a month.

His training as a coast artilleryman must include drill at the guns, instruction in the names, purposes, and methods of assembling of their parts, and in the use of various kinds of fuses, primers, projectiles, and explosives; practice in observing and plotting with the position-finding apparatus, and experience with telephones, telautographs, anemometers, aëroscopes, tide-gages, and search-lights. He may, within a short time, find himself detailed as a cook, bugler, company mechanic, machinist, engineer, fireman, dynamo or storage-battery tender. If he be in a torpedo company, he must also go to small-boat drill, learn to be a gas-engine tender, an assistant to the casemate electrician, and an all-around handy man with cordage, tackle, water-proof joints, and all other details connected with submarine mining.

He must learn the drills and general duties of an infantryman, in order that he may, at an hour's notice, march into a panic-stricken San Francisco and bring order out of chaos, or that he may be used in any emergency where coast artillery is not required; but there is sore need of infantry before volunteer regiments can be organized and equipped. His heavy-artillery experience, if he be a coast-artillery soldier, fits him for siege work, or transfer to the field artillery, where he has at the most but to learn to ride and handle a different kind of gun, while the recruit has everything to learn. His adaptability is one of his most valuable qualities.

If he be especially apt, he may win his way to a course in the Master Gunners' School at Fort Monroe, Virginia, or in the Electrician Sergeants' School at Fort Totten, New York. At the former he receives a course in mathematics, surveying, drafting, and mapping, for the purpose of making battle charts and difference charts for his battery, and computation of range and other tables required in gunnery. At the latter school he gets a very practical course in electricity, covering all kinds of apparatus used in the service. The master gunner at present receives no extra pay, while the electrician sergeant receives but $34 per month and allowances. It is small wonder that these men cannot be induced to reenlist, and yet how desirable it is that the Government should retain the services of such men, after the training it has given them.

RATE OF PAY

In regard to this matter of pay of the enlisted specialist, the following quotation from the report of the chief of artillery for 1904, making a comparison of the pay received by men occupying similar positions in the army and navy, is of interest: "In the army the clothing allowance is in addition to the pay proper, and in the figures given, its value is added to the latter, for the purposes of comparison. Pay for length of service and bounties are not computed in the figures given."

COAST ARTILLERY

Gun commander, $24 per month.

At Guns of 8-inch or Larger Caliber.

Gunners:

First-class, $2 per month extra.

Second class, $1 per month extra.

At Guns of Calibers from 4 to 7 inches.

Gunners:

First class, $2 per month extra.

Second class, $1 per month extra.

At Guns of 3-inch or Smaller Caliber.

Gunners:

First class, $2 per month extra.

Second class, $1 per month extra.

*Distributed at the excursion of the American Society of Mechanical Engineers to the Sandy Hook proving ground.

NAVY

Turret captain, $50 to $70 per month.
At Guns of 8-inch or Larger Caliber.
Gun pointers:
First class, $10 per month extra.
Second class, $8 per month extra.
At Guns of Calibers from 4 to 7 inches
Gun pointers:
First class, $8 per month extra.
Second class, $6 per month extra.
At Guns of 3-inch or Smaller Caliber.
Gun pointers:
First class, $4 per month extra.
Second class, $2 per month extra.

"These figures show that the most poorly paid naval gun pointer receives the same additional compensation as that given to the most highly paid coast-artillery gunner."

In the time of a great war, when the solid, ingenious, and patriotic American citizen feels it necessary to lay down his business pursuits and enter the army, not through spirit of adventure, but because the country needs him, the matter of pay will lose much of its importance and the volunteer artillery will find many men who will easily adapt themselves to the work, after a short interval of service. However, it must be borne in mind that the needs of war-time are immediate and pressing. The first volunteers have been made up, to a great extent, of adventurers and men without steady employment. The cream of the volunteers is not apt to come until the second or third call. In the meantime, the fortunes of war, so far as the vulnerability of our naval and coast defense is concerned, will most probably have been decided. If it were a civil war, where both sides needed two years of fighting to develop armies and leaders, these conditions would not be alarming, but our coast-defense system is intended to meet the attack of an outside enemy, and necessarily one of skill and preparation.

THE OLD COAST DEFENSE

In the early sixties, coast defense in the United States had reached the highest state of development then known, but the introduction of rifled cannon and armored ships made the short-range smooth-bore guns obsolete. The nation emerged from its long struggle, tired of war and all warlike things. The result was that both our navy and our coast-defense system had, at the end of eighteen years, fallen into such a state as to be practically valueless. In 1883, Congress provided for the gun foundry board and authorized the first ships of our modern navy.

REPORT OF THE ENDICOTT BOARD

As the result of the report of the gun foundry board, Congress in 1884 constituted a body popularly known as the Endicott Board. In the following year the report of the board not only laid down the basic principles for a system of coast defense, but also stated in detail the exact number and kind of guns, floating batteries and submarine mines that would be required for the defense of each important port in the United States. This was the plan followed by Congress and the War Department for the next twenty years, but before it could be completed our national development in the art of war made a revision necessary.

REPORT OF THE TAFT BOARD

The report of the Taft Board on February 1, 1906, has given us a new program which does away with the expensive floating defenses (never constructed), by the substitution of modern, high-power, long-range guns; revises the list of home ports to be defended and also provides for our insular possessions and the Panama canal. From this last report it appears that the improvements and developments in materials have been such that a great saving can be made over the earlier estimate. Quoting from the report of the Taft Board, "An adequate defense for the coast of the United States can be secured for $277,239 less than estimated by the Endicott Board. It is further to be noted that the defense of the 22 ports, common to both the past and present systems, can be completed for $22,896,606 less than the sum proposed by the Endicott Board."

Appropriations were meager and progress slow under the Endicott program, until the clamor of the Atlantic seaboard in 1898 for protection against Cervera's fleet, gave its great impetus to the work. Very few indeed of our modern guns were in place at that time. The increase in the appropriations since 1898, to which the ultra conservative are prone to invite criticism, has been largely used in bringing somewhat up to date the work that had been neglected in the preceding twelve years. The country possesses today in material one of the finest coast-defense systems in the world, as the result of those great appropriations while the country was "carried away by militarism," as it has often been termed.

THE FEAR OF MILITARISM

In the face of this wild talk against the great bugaboo, "militarism," Congress has done the best it could, probably, in providing for the material without the men. It is not the purpose of this article to advocate a great peace establishment, which many believe would, from lack of employment, turn to playing politics like the pretorian guard of Rome. The surest way of avoiding such a calamity is to keep in peace the minimum number necessary to prevent the knowledge of war from becoming a lost art among our people, against the time of its sore need to avert national disaster, and to keep this small body fully occupied with perfecting itself and laying plans for the defense of the country. More than this, our most pro-military writers have not advocated. The bone of contention is what this minimum should be.

This lack of confidence in the regular, among some of his fellow citizens, is a matter that he feels very keenly. If he be an officer, he must be a full fledged American citizen; if he be an enlisted man, he must at least be so attached to our republican institutions as to have declared his intentions to become a citizen and to swear that he "will bear true faith and allegiance to the United States of America" and that "he will serve them honestly and faithfully against all their enemies whomsoever." Our American regular is a member of some American family and his sympathies lie with its members and their welfare as truly as do those of any citizen. He is no paid hireling nor soldier of fortune. He is a voter, whenever his duties permit him to return to his legal residence. In no man can you find a higher degree of patriotism, or a keener sense of duty in his allegiance to the republic.

CONDITIONS OF A FIGHT

Under the best weather conditions a hostile ship may be sighted about 12 miles at sea in the daytime, or, by the use of the most powerful 60-inch search-lights, at a distance of 7 miles, or 12,000 yards, at night. A rather slow rate of speed for an attacking fleet would be 15 knots an hour, for a cruiser squadron 20 knots, and for a torpedo flotilla, making a dash, about 27 knots. That is, for a day attack from the time a call to arms could be sounded until the fleet had run by, less than 42 minutes would elapse. For the cruiser squadron, this time would be but 30 minutes; while for the torpedo flotilla, it would be but 23 minutes. At night these times would suffer a 43.25 per cent. reduction, leaving them as 23.6 minutes for the fleet, 17.7 minutes for the cruisers, and 13.3 minutes for the torpedo flotilla. It should be borne in mind that these times are computed from speeds which are only 70 to 90 per cent. of the trial speeds already obtained with the various classes of ships.

The choice of the time and conditions lies with the naval commander, and certain he is to choose those most advantageous to himself. His crews may remain snugly in their hammocks until "general quarters" is sounded, while the coast artilleryman must keep every gun, every range-finding station, every power plant, every search-light and every casement constantly manned with its full complement day and night. This condition at the seat of war might easily extend over a period of six, nine, or even twelve months. Two complete reliefs for all stations, and three for the most trying ones, are then imperative. Fancy, if you can, the physical and mental strain under all conditions of weather, with possibly an enervating cli-

mate, for even the man with four hours on and eight hours off.

It might be argued that this is but a special case of attack, and that the usual form would be that of a bombardment. Experience, however, goes to show that modern naval battles are of short duration, and that both parties emerge in a state of physical and nervous exhaustion. In fact, both the battle of Manila bay and the battle of the Sea of Japan had two distinct parts. Under such conditions, perhaps after weeks of false alarms, a fresh relief after an engagement becomes an absolute necessity.

WHICH SECTION WILL BE FREE FROM ATTACK?

It will be conceded at once that under certain conditions some large section of our coast may be freed from the dangers of attack and that the garrisons along this coast may be depleted. This is a war condition. We come now to the difference between war and peace conditions. Can you select now this section which will be free from attack in our next war? And would not your very selection and consequent neglect of that section invite the attack upon the weak point? Nothing remains but to be prepared at all points in proportion to their relative importance. It is quite impossible to think of permanent defense at any but the most important ports. Landings at out of the way points must be met by the mobile army, and whatever extemporized means the time will permit. In fact, the fixed defenses must depend upon the mobile army for security from land attacks in their rear.

ASSIMILATING RAW RECRUITS

The question of the minimum peace strength required now resolves itself into determining the minimum garrison required at each fortification to keep the material in its highest state of efficiency, and to be capable of readily assimilating several times its number of raw and inexperienced recruits of both officers and men. It is difficult to find an analogue among our various commercial industries, but let us take a large machine-tool plant. What is the minimum proportion of experienced hands of all the kinds you required with which you would undertake at once to turn out the maximum output of the plant, working night and day, when you must also keep the plant in repair and protect it from damage by fire and the spies of your rivals, and at the same time feed, clothe, house and doctor your men, supposing that your new hands, from superintendent down, must come from all other professions and trades other than that for which you require them? Would one complete shift of machinists, engineers, clerks, property men, and cooks be too much? It is from such a standpoint that we urge that one complete relief for the coast defenses is necessary in time of peace.

The comparison falls short in supposing that your new hands would be readily available. To see the truth of this, one only has to recall the experiences of 1898, when it was nearly two months after the declaration of war before the first volunteers were gotten upon the field of battle with an obsolete weapon that made them quite as much of a nuisance as an aid. This was not the fault of the War Department nor of Congress. This condition was the result of public opinion. The Japanese torpedo boats struck the Russian fleet in the harbor of Port Arthur before the declaration of war. There is ample time for a series of great national disasters between the declaration of war and the time when our first volunteers can be brought to the scene of action, especially in our more distant possessions.

THE FORCES NECESSARY

Quoting from the annual report of the chief of artillery for 1905, we find that "The force necessary for one complete manning detail for all the elements of our coast defense, including the 169 officers and 4970 enlisted men required for torpedo defense and power plant and search-light service, is 1754 officers and 41,833 enlisted men, of which we have respectively 525 and 13,734." This was based upon the number of guns then erected, and takes no account of the later additions to our home defenses or those of our outlying possessions. From this it appears, deducting officers and men on detached service and at service schools, that but a little over one-fourth of the batteries now completed are in actual use. The remainder are laid up in the hands of caretakers.

The Board of Review of the Army and Navy Joint Exercises, June 11-17, 1905, made the following comment upon this point: "The most important object lesson afforded by the joint exercises was found in the fact that to provide officers and men sufficient to provide one relief for the operation of the elements of defense, it was necessary to practically strip the Atlantic and Gulf coast of artillerymen. The insufficiency of the present personnel of the artillery arm to man the coast defenses of the country was strikingly illustrated. The total number of troops engaged in the exercises was 5927. Of these, 1898 were permanently stationed in the exercise area, and 4029, comprising 37 companies of coast artillery and several detachments of hospital corps, signal corps, etc., were drawn from elsewhere. All the artillery posts from Fort McKinley, Maine, to Key West, Florida, were crippled to supply the needed one relief. These are certainly not service conditions."

SHORTAGE OF RECRUITS.

Not only this, but the conditions are worse than these figures represent, since "Of the force that is authorized by law, the artillery corps is short from 30 per cent. to 40 per cent. because of the inability of the recruiting department of the army to keep the artillery supplied with recruits. This is due to the fact that these men are called on to do so much in consequence of the shortage of men, and get such little compensation for their labor that they will not re-enlist." (Report of Senator Warren, Chairman of the Military Committee, U. S. Senate, during the last session of Congress, upon a measure for the relief of the artillery corps.)

The modern field artilleryman must receive nearly or quite as technical a training as his comrade in the coast artillery. Within the last year he has been equipped with a new rapid-fire gun on a hydraulic recoil carriage, the first in our service, and with practically all-steel limbers and caissons. The forge and battery wagon accompanying each battery is a marvel in the way of a shop on wheels. The greater complexity of the new carriage has added much to the difficulties of training the inexperienced officer or soldier, but the climax is reached by the new system of fire control, by which the fire of whole regiments and even brigades of field artillery is directed upon an unseen enemy by the commander, who may be at a considerable distance from the batteries.

TIME REQUIRED FOR TRAINING

It has been seen how progress in the art of war demands a great increase in the technical training of the personnel. Just as it now takes years to build ships and prepare the material for war where it used to take months, so now it requires years to train the personnel where weeks once sufficed. A greater degree of preparedness is requisite in proportion to the scientific nature of the service to be rendered. Having in mind this principle, allow me to quote from the letter of the President of the United States to Congress on March 5, 1906. "The necessity for a complete and adequate system of coast defense is greater today than twenty years ago, for the increased wealth of the country offers more tempting inducements to attack, and a hostile fleet can reach our coast in a much shorter period of time. The fact that we now have a navy does not in any wise diminish the importance of coast defenses; on the contrary, that fact emphasizes their value and the necessity for their construction.

COAST DEFENSES NECESSARY FOR THE NAVY

"It is an accepted naval maxim that a navy can be used to strategic advantage only when acting on the offensive, and it can be free to so operate only after our coast defense is reasonably secure and so recognized by the country. It was due to the securely defended condition of the Japanese ports that the Japanese fleets were free to seek out and watch its proper objective—the Russian fleet—

without fear of interruption or recall to guard its home ports against raids by the Vladivostock squadron. This, one of the most valuable lessons of the late war in the East, is worthy of serious consideration by our country, with its extensive coast line, its many harbors, and its many wealthy manufacturing coast cities. The security and protection of our interests require the completion of the defenses of our coast."

In the artilleryman we find a soldier who is a mechanical and electrical engineer. To his charge is intrusted probably as fine a system of coast defense as has ever been constructed, but even now, when our home defenses are far from complete, and practically nothing has been done toward fortifying our insular possessions and the Panama canal, he must lay up in paint and cosmoline three-fourths of all this fine equipment, and do the best he can to keep the remaining fourth in operation with a force that is short-handed 30 to 40 per cent. He is provided with excellent schools and means of training the experts which he requires, but upon the completion of their enlistment he sees all his work go for naught, because they are underpaid, and the commercial world stands ready to invite them at nearly or quite twice their army pay.

THE BREAKING POINT REACHED

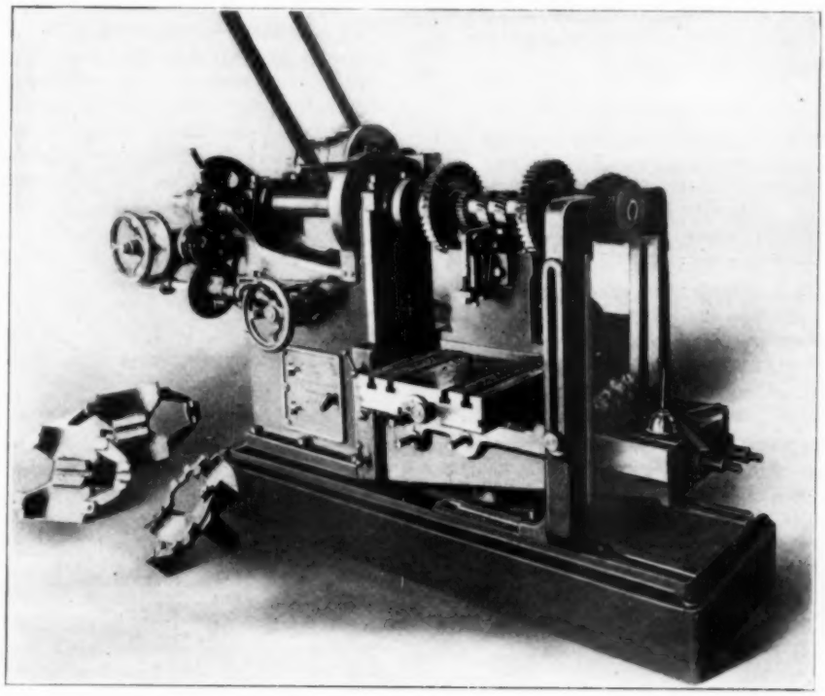
Lieutenant Colonel Harrison, while acting chief of artillery, stated the situation in a nutshell. "We are seeking a let-up on this present situation. It has gotten to the breaking point. The men will not re-enlist; many of them desert before their time expires, and the officers are becoming somewhat discouraged. The engineers have been adding to the plant from time to time and turning over to us new fortifications and new works, new accessories, new power plants, new electrical installations, and new search-lights until we are about ready to give way under the burden; we cannot properly meet the responsibility that is accumulating about our shoulders."

If that is the situation in peace, what will it be in war?

An Unusual Milling Operation

BY HUGH DOLNAR

Referring to the 32-spindle drilling machine used by the Couple-Gear Freight-Wheel Company, of Grand Rapids, Michigan, and shown at page 16, the electric motors in the wheel hubs of the couple-gear trucks are carried in a frame made up of two steel castings, and these frame parts have long hubs which are finished to take cages of roller bearings and serve as the wheel axles. The complete wheel and motor assembly weighs 700 pounds, and must be a very close job. The meeting faces of the motor-frame castings are babbitted together, and are finished by a gang of Pratt & Whitney mills, shown in the illustration, which also shows the frame parts in the left foreground.



BINSSE BORING MACHINE MILLING COUPLE-DRIVE MOTOR FRAMES

The shanks on the frames are so long as to make either a high fixture or a special milling machine necessary, and Mr. Knudsen decided to put the job on a Binsse boring machine, all as shown in the illustration. The Binsse boring machine was certainly never designed to carry any such cut as this gang of six mills takes, and the framing and slide were never expected to resist such stresses as this high fixture entails, but the machine stands up well, and makes the 24-inch length of cut well inside of an hour.

Some of the old fellows can remember the oak-frame milling machines of early days, examples of which are said to be yet in existence in the lofts of Colt's armory, and so might not be much astonished to see this cut on this fixture on the Binsse boring machine going along in fair shape. It surprised me, all the same, and this application of the boring machine to a large and very awkward milling job may give a valuable hint to others, who, like Mr. Knudsen, are in a hurry for work, and cannot wait for special tool building.

A Thorough Application of Electricity in New York Iron Mines

On the Lake Champlain shore at Port Henry, New York, an electrical installation is being made which is an interesting example of the growth of electricity in mining. The mines of Witherbee, Sherman & Co., which are scattered over a considerable area, yield upward of half a million tons of iron ore annually, which output is expected to be increased to one million tons when the new electrical equipment is completed. The transmission of power to the various shafts is by alternating current, and 440-volt induction motors are used for driving hoists, pumps, air compressors, etc., the frequency being 25 cycles. The current is generated in several power plants, using both water and steam power, and in the latter both steam engines and steam turbines are used. At one of these plants, the Kingdom plant, a Pelton impulse wheel under a head of 200 feet, drives the generators, the water being carried for 1⅛ miles through a 32-inch pipe. The current is carried eleven miles to Mineville, at a potential of 6000 volts. At Port Henry a modern steam-generating station is being built of reinforced concrete with a stack of the same material. The boiler room contains four 500-horse-power B. & W. boilers, with space for two more; the generating equipment consists of an 800-kilowatt Curtis steam turbo-generator, with space for a second one. This being a vertical unit, the disposition of the space in the generating room has been extremely economical. The switchboard gallery has a reinforced concrete floor, which also supports motor-driven exciter sets, and a supplementary exciting unit is provided by a 25-kilowatt horizontal Curtis steam turbo-generator.

SHOP TOOLS AND METHODS

Convenient Appliances for Small Work, and Handy Ways of Performing Accurate Operations

BY F. J. LE CARD

Fig. 1 shows a box tool, used in this case in the bench-lathe tail-stock. The bushing *a*, of which different sizes can be used in the same box, is made to fit any size wire required. Fig. 2 shows an end view of the cutting tool *b* in its relation to the bushing; it is held by a set screw on the flattened top.

PROVISION FOR ADJUSTING THE BOX TOOL

The tool is adjusted to the cut by the screw *c*, Fig. 1, which screw has a flange coming between the head of screw *d* and the body *e*, thus allowing it to act as a regular feed screw.

The stop or end-adjustment screw *f* can be held with screw *g*; or by slitting and expanding as shown at *h*. This latter scheme gives a fine tension.

The body *e* is of mild steel about ½x1¼ inches, centered and turned to shape and milled across for the opening.

A LOCATING PUNCH FOR FACE-PLATE WORK

I carry in stock a number of circular punches, like Fig. 3, mostly for transfer work on the drill press. Incidentally I use them for locating work on a face plate where it is required to remove stock at the side of a hole already made. A job of this kind is shown in Fig. 4, which represents a round die. I bore out and finish the round part *i* of the die, then to save filing the irregular part clear through, I turn out the part of circle *j* at the back of the die. I locate the center *k* when laying the die out, and, finding this with the pump center of the bench lathe, bore out the back clearance *j* the first thing.

HOW THE PUNCH IS USED

Using the parallel bars, shown by dotted lines, to transfer the irregular form of the die from the face to the back, I hold the punch, Fig. 2, against the work and mark around it, moving it to suit me, and then strike it with the hammer for an impression. Then I catch the punch in a chuck which fits the tail-stock spindle of the lathe, and use it to locate the work by the stamped mark until the clamps are secured on the face plate.

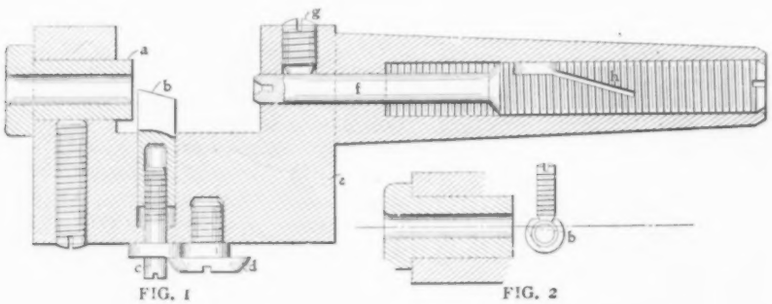


FIG. 1

FIG. 2

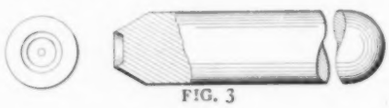


FIG. 3

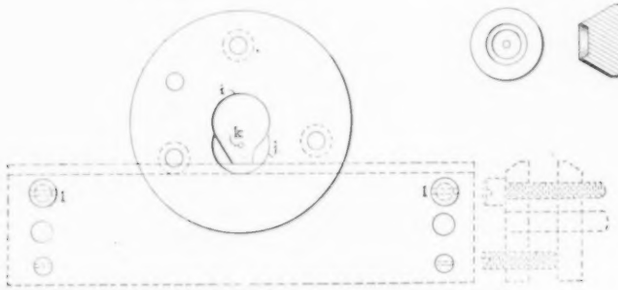


FIG. 4

SHOP TOOLS AND METHODS

This is only an off-hand way to get an approximation to the true shape without plugging the hole *i* and finding a center *k* for circle *j*.

TRANSFERRING LINES FROM THE FACE TO THE REAR OF WORK

I sometimes get an opposite parallel line by holding the work in a small Vanderbeek or other drill vise, resting it on the surface plate and transferring from front to back with the surface gage.

Again I put small pieces in a Billings & Spencer vise which has parallel jaws, line the work in front with the front jaw, and use the back jaw as a straight edge to get a line opposite the first on the back of the piece.

A PAIR OF FILING BARS

The parallel bars shown by the dotted lines in Fig. 4 have been used for years on work, when I wished to file through a die quickly to line. They are of mild steel with beveled edges, which are tinted with blue stone and replaned or milled, as needed. The screws *l* clamp the work and the other screws place the bars parallel with it, while the dowel pins keep the edges of the bars parallel.

ADAPTER FOR SQUARE STOCK

Fig. 5 illustrates an adapter for square stock to be held in a spring chuck *m*. A piece of round stock *n* is bored centrally and filed out square to right size and split at *o* for closing on the work. The pin *p* gages the work in the adapter and the pin *q* gages the latter in the chuck. In this way the work *r* can be readily duplicated as to length.

MILLING SMALL STOCK

Fig. 6 shows a slabbing device for sizing square stock such as that held in the adapter in Fig. 5.

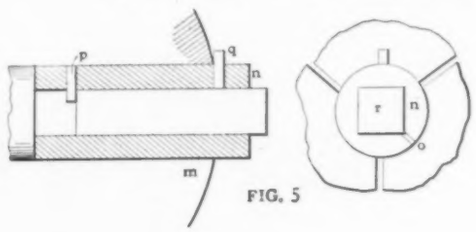
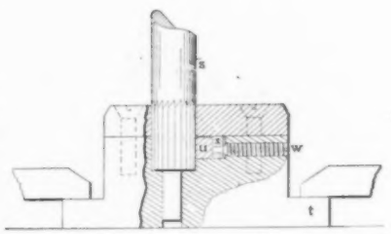


FIG. 5



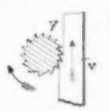


FIG. 6

The milling cutter *s* may be held in a drill press and the guide block *t* fastened to the table. The stock is then pushed through the opening, as seen at *u*, and against the cutter as at *v*.

The screws *w* hold the gib *x* which gages the thickness to which the stock is cut, and the face of the guide block in the rear of the cutter should correspond to the milled face of the work at *y*.

It is announced that the War Department has appointed a board to test automatic pistols at the Springfield armory, with a view to the selection of such a pistol as will be suitable for use by the army.

Sammy's Shop—Various Kinds of Customers and the Necessity for Diplomacy in Dealing with Them

It was soon evident to Sammy after he had started in business that many people do not pay for machine work when they get the work done, and soon a lot of notes accumulated. These were supposed to contain all of the details both of material and of time; but most men did not care to wait "forever" while the items were being looked up when they came in with the money to pay a bill—and, besides that, it took time from the work to do the looking up; and then there was always the risk of overlooking some item.

SHOP BOOKKEEPING

In this matter Mrs. Sammy took a hand and opened up a set of books. To keep track of all work done, slates were bought. Each one (Sammy and Albert) was supposed to put down each job done and the time and material. This was a blow to Albert. It took constant watching to keep him reasonably near right. He would get so interested in the work he was doing that he would forget all about the flight of time. Often he would have two jobs going at once and he would forget to charge one of them. Sammy was more careful, because it meant his bread and butter to him, and as time went on the need of being careful was shown in a way that he had not anticipated.

CUSTOMERS AND WHY THEY CAME

Mr. Davis sent in work because he had a financial interest in having the shop prosper, and perhaps somewhat because he had a general interest in the small and struggling industries of the town. A number of others came because of the same feeling of general interest. A few came because they were personal friends of Sammy, and a few more because they were personal friends of Mr. Davis. By far the most of them came for purely personal reasons. The man who did not like the other shops came, and so did the man whom the other shops did not like. The man came who wanted to hang around all the time his work was being done, for fear it would not be done right if he did not do so; and so did the man who was afraid of being overcharged unless he was always on hand; and mixed up with them all was the man who never paid a bill unless forced to do so.

FRIENDLY POINTERS

Owing to the friendly interest of Mr. Davis, Sammy had been put on his guard to some extent, but for all that it took him some time to find the measure of some people.

Among his customers was a Mr. Bew. Mr. Bew was a man of some means and was engaged in a number of enterprises. Sammy had done a number of jobs for him. One day he came rushing in with a drawing of a cutter head, of a special design, that he was intending to use on a wood-working machine. It was to be used in his factory and was an improvement he had invented.

A CONCEITED INVENTOR

Sammy knew very little about working wood, but thought that there might be a question as to the proper working of this sort of a head. Mr. Bew gave him to understand that the design was perfection itself. What he wanted was to have it made. So sure was he that he wanted several made. If they worked as he expected them to do he would need a number of them, and by making them all at once the cost would be greatly reduced. Sammy made them to the sketches furnished, and Mr. Bew looked them all over before taking them away, and did not find any fault; neither did he pay for them. This did not surprise Sammy, for he generally waited until he received a bill, but he always came in promptly after that.

THE DISSATISFIED CUSTOMER

The bill was sent but brought no response, and finally Sammy hunted him up. He was more than surprised at the stand taken by Mr. Bew.

"Sammy, I have been doing everything I can to make that job of yours work as it should. If I can make it work so that it will be of any use to me, I will pay your bill, although I really should charge you with the expense I have been to, fussing with it. I am sorry for you, but you will have to learn to do your work right if you keep at the business. I am not saying anything about it to other people, for I don't want to hurt your trade, with you just starting in so."

"I made them just according to your drawings and your orders," protested Sammy. "If they don't work that is not my fault."

THE BILL IS NOT PAID

"Sammy," he said, with scorn, compassion, and indignation in his tone, and in his glance, "you are too young to stand here and tell me that I do not know my business. I have forgotten more about it than you will ever know. I know what I am talking about. If you don't agree with me go ahead and try to collect that bill. I'm worth it," with a wave of the hands that seemed to indicate that he owned a good share of the world in that immediate vicinity. "To be just to myself I ought to sue you for damages."

Sammy felt that he was imposed upon, but did not see how he could help it. He had very little knowledge of the law, and had always looked upon lawyers as expensive luxuries.

SOME GOOD ADVICE

"Don't be in too big a hurry in such matters," said Mr. Davis when Sammy asked his advice, "and don't act sour over it. Treat Mr. Bew just as nicely when you meet him as you ever did. Even if you have to 'lick' a man don't act 'grouchy' toward him after it is over. Do him up good while you are at it, if you can, but even if he 'licks' you instead of you 'licking' him, act civil afterward. Your chance of getting another 'go' at him is just as good as it would be if you refused to speak to him, and it makes you look better to other people."

This was not Sammy's natural disposition, although he saw the sense of it. He wanted to fight, and felt that he could lose the amount with a better grace afterward; but there was more advice along the line of law and common sense, and he cooled down, and whenever he met Mr. Bew tried to act as if he had forgotten all about the bill.

THE CUSTOMER RETURNS

As time went on Mr. Bew came with other work. All of the jobs were small, and he paid for them when he came for them. One day he came in with sketches of a machine he wished built. Sammy gave him a price on it and he left the order. Most of the machine was made of wood, and he was to furnish that part, and Sammy was to put on the iron work. The wood frame was sent down, and Sammy began work, and he also took council with Mr. Davis.

Mr. Bew was in a great hurry to get the machine, and came in frequently to see how it was getting along, and on Saturday afternoon he sent a dray for it.

QUESTIONS AND ANSWERS

"Did he send any money with you to pay the bill?" asked Sammy. "I cannot let it go until I get my pay."

The man had not been given any money and went away, and in a few minutes Mr. Bew came rushing in with fire in his eye. Sammy received him very pleasantly.

"What is the matter that you did not let that drayman have this machine?" he demanded.

"My bill isn't paid yet," said Sammy, without the least show of emotion.

"Isn't my credit good for a bill of that size?" he exclaimed in a voice that was much louder than was necessary to make himself heard even in a machine shop.

"No," said Sammy, in the same quiet voice.

AN ITEMIZED ACCOUNT

He glared at Sammy, and there were many things that he wanted to say, but he was a trained business man. Finally, he got control of himself enough to snap out: "Where is your bill?"

Sammy had it all ready and handed it to him. He glanced at the footing and looked astonished. As he ran his eye up the astonishment changed to rage. The cutter heads were included in it.

"I told you I would not pay for those heads. They never worked. I will pay for this last job and you will never get another one from me. You can be sure of that."

"You can have that machine as soon as you pay the entire bill, and not before. My work is on it."

"Take your work off. I will take my stuff somewhere else."

That was just what Sammy was not ready to do. The woodwork was worth much more than his bill. "It is 5 o'clock, and time to close on Saturday night."

DELIVERY DEFERRED

Mr. Bew made some sulphurous remarks but pulled out his checkbook and wrote a check for the amount of the bill. "I will have a dray here in a few minutes" said he, as he took the receipted bill and started for the door.

"Do not have a dray come until after 9 on Monday morning," said Sammy, "for he cannot get the machine if he does."

Mr. Bew turned and looked at Sammy as though he did not comprehend the meaning of the remark. "It is all done, is it not?"

"Yes, the machine is all done, and I think this check is all right, but the bank does not open until 9 o'clock. I have found that it is as well for a man to be sure when he can do so without going to too much trouble, and this will only delay you for two hours, for, of course, you would not be able to do anything with the machine on Sunday."

THE COOL MACHINIST

Business man that he was, Mr. Bew forgot himself and said some very ill considered things, but through it all Sammy kept perfectly cool, and did not say anything that could give offense. He believed he was acting within his rights, and that he had the power of enforcing them, and was determined to do so; but he had been learning some things about the manner in which he did it.

That machine went out on Monday morning, after the check had been paid at the bank; and you may think it strange, but that was not the last job he did for this man. It was certainly a surprise to Sammy to have him come back, but it stiffened his backbone a little, so that it was not as hard as it had been to demand payment before letting a job go.

CASH BUSINESS

In some sections it may be quite the custom to do a strictly cash business or even get pay before a job is started, but in a small place where everybody knows everybody else at sight, at least, it is a different matter, and it took some diplomacy to do it without giving offense.

"Young fellow, you act as if you didn't think I am honest," spluttered one individual when pay was demanded.

"I am so poor that I have to have the money to keep the people I deal with from thinking I am not honest," was the reply, given in a confidential tone.

"You must be awful hard up," sarcastically exclaimed another.

"I am," was the frank response. "If you want to know how big a dollar is and how hard it is to get it, get into the machine business."

"If my way of paying don't suit you, you can keep the job. I pay when I get ready, and not before. Now what are you going to do about it?"

ANOTHER BILL COLLECTED

It wasn't poverty, but it was meanness that kept this man from paying, and his air was particularly aggravating. Sammy promptly decided to see if he could not persuade him to "want" to pay that bill and take the job, which was of no use to anyone but the man who had ordered it.

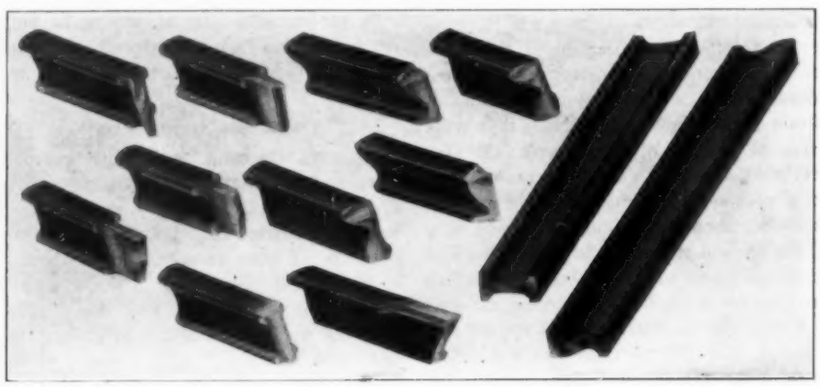
He stepped between the man and the door and pulled up the sleeves of his jacket. "If I can't get it in any other way I will just take the worth of that job out of your hide, and if I have to collect it that way you can bet that I will take good measure."

"Why, you G—," his wind was shut off at this point, and his head was bumped against the wall. Sammy did not strike him, but the feel of that grimy hand on his neck made him think that way down in his heart he really did want to pay that bill, for he paid it, while Sammy expressed regret at having to be so violent in helping him to see his mind.

It takes diplomacy to run a little jobbing shop. W. OSBORNE.

High-speed Steel Shapes for Lathe and Other Work

The illustration shows a new departure in the manufacture of Novo high-speed steel for lathe, planer and shaper tools. It consists in the rolling of the steel to I- and Z-sections as shown. By using these shapes, forging, for the general run of tools, is entirely eliminated and the tools are merely ground to shape and tempered. A further advantage is in the cost of the material. For, while the shaped bar possesses greater strength than a rectangular bar of the same weight per foot, it is considerably lighter than a bar of the same outside dimensions. In the I-section this saving in weight is 45 per cent., while in the Z-section it is 35 per cent. This steel is sold by Hermann Boker & Co., 101 to 103 Duane street, New York.



THE TOOLS AND THE BARS FROM WHICH THEY ARE MADE

Some Advice on Model-making

There is no more certain way of wasting your time than by making a model of a locomotive. The parts are so numerous that not one model in 50 is ever finished. Even if it is finished, you will have learned nothing of value. The same objection holds good with regard to models of fixed engines. The small steam engine is being rapidly superseded by oil and gas motors, which, on a small scale, demand very delicate workmanship. The small hot-air engine is the simplest of prime movers using heat, and as it can be run with the aid of a lamp, and needs no boiler, it gives very little trouble in working. There is also considerable scope for improvement in the design of the small hot-air engine, as it is too often only a reduced copy of a large one, with many unnecessary complications of construction.

If you want a really profitable amusement, you will find it in a working diagram of the valve gear of a locomotive, which you may make principally of wood and sheet metal. The principal piece is that which represents the eccentrics and the crank arm. The throw of the eccentrics must be variable and also their angle toward each other; and the joints should have the smallest possible amount of play, so as to avoid lost motion. With this instrument you may observe the effect of various arrangements of valves and of reversing gear. The apprentice who wishes to rise beyond the position of a workman must know more than his fellows; he should, therefore, choose his mechanical amusements from among those subjects which will improve his efficiency.—*The Indian Textile Journal.*

At Greensburg, Penn., recently, a heavy drill point stuck in a well at a depth of 250 feet. It was loosened and brought to the surface with the aid of an electromagnet.

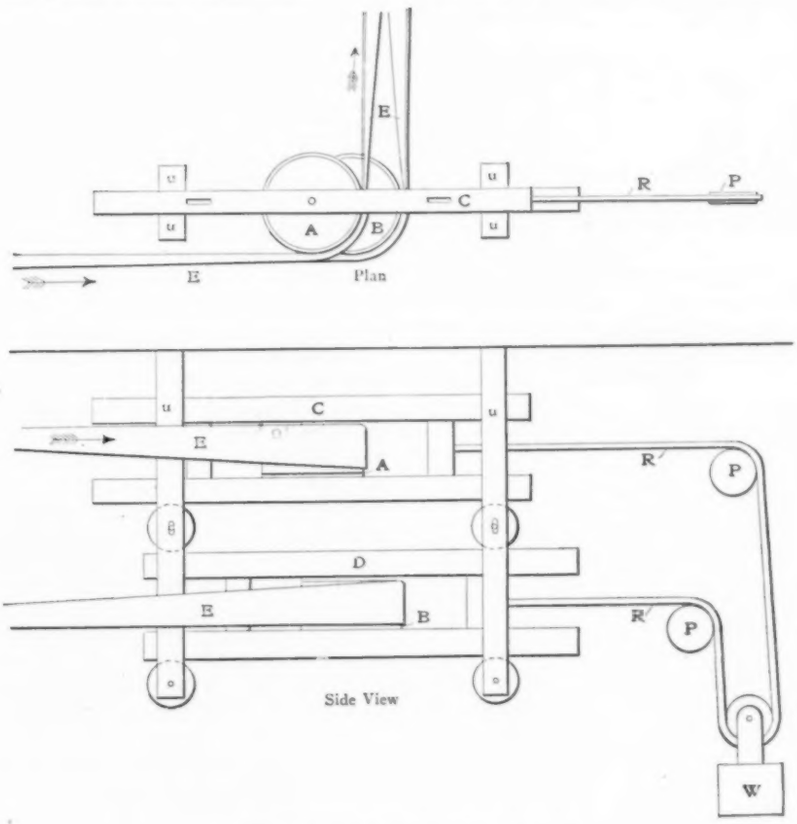
CORRESPONDENCE

Discussing Phases of Machine Design and Construction

A Novel Guide-pulley Arrangement

The transmission of power from one shaft to another, at right angles with it, is one of those problems which has a multiplicity of solutions, yet none that can be considered entirely satisfactory. Bevel gears, either spur or friction, have many objectionable features; and quarter-turn belts, unless the shafts are in widely separated planes, are an abomination.

In my wanderings I recently noted one, however, which seems to have overcome the difficulty in a simple and effective manner. The accompanying diagram shows a plan and side view of the arrangement. In this diagram *E* is the belt, running in the direction indicated by the arrows, which point toward the fast and loose pulleys. The guide pulleys, *A* and *B*, are set in the rectangular frames *C* and *D;* which frames slide freely between the uprights *u, u, u, u*. The ends of the cord *R* are secured to the frames, from whence it runs over the pulleys *P P*, placed at any convenient point, and the weight *W* hangs, by another pulley, in the bight of it. The weight is sufficient to give the desired tension to the belt.



A NOVEL GUIDE-PULLEY ARRANGEMENT

Two shafts, angularly related, in the same plane, are often connected by a belt running over guide pulleys; but an oft-times serious objection to this method is that it precludes the use of fast and loose pulleys on the driven shaft. In wood-working shops it is usually desirable to have the lathe set at right angles with the main shaft; and the countershaft, with fast and loose pulleys, must be in line with the lathe bed. Many and curious—sometimes fearful and wonderful—are the means used to accomplish this result.

When it is desired to shift the belt, the frame *C* is moved in the desired direction—either by pulling on the cord *R* or by any convenient method—while the frame *D* automatically moves the same distance in the opposite direction. As the side of the belt running onto the pulley determines where it shall run, the location of the guide pulley *B*, within ample limits, is immaterial.

This arrangement has the advantage over even a straight belt with an ordinary shipper that there is no rubbing friction on the edges of the belt, and that the tension is constant, taking care of quite an amount of stretch without any change in the driving efficiency. G. W. D.

[The pulley *A* must obviously be held in position, as otherwise the greater pull on the driving side of the belt would cause it to travel to the right. If the left-hand position of *A* corresponds with the loose pulley, friction of the slides may be sufficient to prevent displacement, in which case a stop to prevent overtravel to the right would be sufficient.—Ed.]

A Lesson in Economy

As the master mechanic was going through the shop on his tour of inspection, he stopped in front of a lathe where one of the men was working, and asked, "Harry, what are you worrying about?"

"Well," said Harry, "to be real honest, I can't understand how it is, that, when I'm making 35 cents an hour I can't lay up any money, and some of the fellows in here who are making less, and have a family to support, have laid by enough to buy a home or start some little business of their own."

"Is that all? Now, let's see, 35 cents an hour, 54 hours a week, makes $18.90; counting what days you are compelled to lay off with sickness, holidays, etc., we'll say you make $18 a week the year round. Then another thing, when you buy 35 cents' worth of cigars, or the like, don't you say to yourself, 'There goes an hour's work?'"

"Yes, I do say that very thing."

"Well, the trouble with you is this: you think you are worth 35 cents an hour to yourself, and you're not."

"How is that?"

"How much are you compelled to spend on yourself every week?"

Harry does a little mental figuring and replies, "Nine dollars."

"Well, here we have $18 a week, the amount taken in, less $9 a week, the amount you are compelled to spend, which leaves you $9. In other words, for every hour of the nine a day you work, it costs you 17½ cents to place yourself here in good working condition, and you have

17½ cents for yourself, which you can spend for amusement, etc., or save. Now, the next time you buy 35 cents' worth of cigars, or the like, just say to yourself, 'There go two hours of my work.'"

R. K. L.

Descriptive Dimensions on Drawings

I believe there has been some discussion of this subject in these columns, especially in reference to manufacturing work, and I would like to add a little on the peculiar need of such figuring on tool work.

In many tool rooms it is customary to have a good deal of the detail drawing on jigs, fixtures, etc., executed by men who have no opportunity to know exactly what duty the parts they handle are to perform, or the place they are to fill, and the dimensions being given in plain figures give no indication of the degree of accuracy required.

A man who is given the assembly and detail drawings and told to go through with the job, if he possess the necessary mechanical instinct, will soon see what dimensions are vital, and work accordingly to obtain the desired result. But it is the man who has the machine work on the detail to do whose cause I desire to champion. How many times, not wishing to put needless accuracy (and consequently time and money) on a job, have I appealed to the foreman, to be met with the utterly foolish reply: "Work to the drawing," and a look of contempt for my ignorance. I have then gone on and made such work as close to size as I know how, only, perhaps, to discover subsequently by observation that the said work when assembled, was intended to fill snugly "a hole in the air."

There are four classes of figures that should be taken into consideration: First, essential dimensions that directly influence the accuracy of the work produced (such as the stops and holes of a drill jig), and are thus of cardinal importance; second, dimensions that influence the successful manipulation or operation of a tool; third, dimensions which are only given because they cannot readily be omitted, and a substantial departure from which would not affect the operation or render the design in any way defective; and fourth, relative dimensions which in themselves are not important, but merely relate to other parts that require to be duplicates.

I suppose exception might be taken to the last named as it is considered good practice to duplicate such dimensions by reference to some independent standard of comparison, or measuring instrument; but there are many instances in which two or more pieces can be made duplicates by tooling, etc., without necessarily closely conforming to any standard dimension.

I am not going to suggest any system of figuring to meet the need. I have endeavored to outline, but will confine myself to the negative side of stating the case and leave the remedy to someone else. But I will, in conclusion, offer a word of counsel to any bosses who may read this, to pay a little more respect and attention to the man who asks questions, for the habit of questioning is one of the surest indications of gray matter that I know of.

GEORGE GAY.

Graduating a Protractor

I have been asked by several persons how a protractor, like the one shown at page 153, Vol. 29, Part 2, could be graduated without the aid of expensive tools. Thinking it might be useful to some of your readers I inclose a sketch of a very simple method whereby almost any machinist can do the work with a fair degree of accuracy.

In Fig. 1 2 is the plate to be graduated; 1 is a J. Stevens Arms and Tool Company's protractor, which has its outer edge

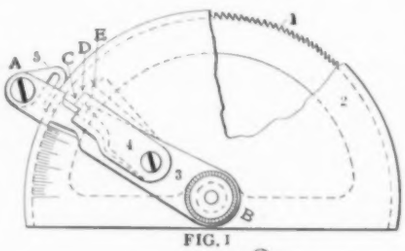


FIG. 1

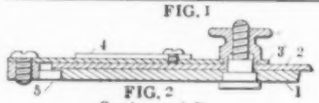


FIG. 2
Section at A-B

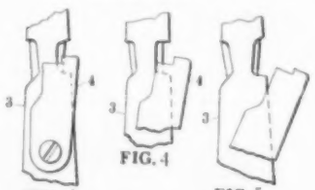


FIG. 3 FIG. 4 FIG. 5

GRADUATING A PROTRACTOR

milled to correspond with the degree marks on its face; 3 is a swinging arm, supporting the spring 5; 4 is a finger made to swing to three different positions, as in Figs. 3, 4 and 5 as a guide for scribing long or short lines.

Protractor 1 and plate 2 are clamped tightly together with a thumb nut, arm 3 being a working fit on the thumb nut, as shown in Fig. 2.

When all parts are clamped together, place arm 3 in position for the first line with spring 5 in the milled notch and finger 4 set for a long line as in Fig. 5. Scribe the first line with a sharp tool or scriber, and swing arm 3 until spring 5 snaps in the next notch. Set the finger back, as in Fig. 3, and make four short lines, after which set the finger as in Fig. 4, and scribe the fifth line, and so on, taking care to move arm 3 one notch for every line and to set finger 4 in the correct position.

H. J. CHINNECK.

Muscatine, Iowa.

Learning to Act

When I was a small boy I lived on a farm. It was one of those New England farms where the land is set up on edge so much that mowing machines will not be in great demand until they are built with flying-machine attachments. This was long enough ago so that mowing machines held pretty much the same relation to mechanical work that flying machines do today; but nevertheless the grass had to be cut, and I had to help. Now any live boy, whether in the shop or field, knows that the more he knows, the easier it is to earn his way. I was not content to spread and rake after and stow away; I wanted to mow, just as any boy in the shop wants to get on another machine, because it looked bigger—more like a man's job. My father had a man who worked in his shop in the city who came out every summer and did the haying with what help he could get out of me. I teased "Bings" to teach me to mow, but he would not, said he had all he could do to do the mowing himself without teaching me. So I teased my father till he stayed at home ten minutes later than usual in the morning and taught me how. All he did was to watch me try and tell me to stand up straighter and keep the heel down and not dig the point in; but he had to tell me every other stroke.

When Bings came I marched out as big as life to help. I fell in behind and struggled to keep up. It went finely for a few minutes, but then it seemed as though my scythe would only knock the grass over. When Bings was ready to grind he ground his scythe, I turning the crank, and then mine. I noticed that it only took about a quarter as long for mine as for his. I mentioned it to him and he told me that I had not used mine long enough to dull it; but, when we got out in the field again, it seemed to give out at once. Bings said it was I, not the scythe, that I was too young to mow, anyway, and I went back to my old job spreading and turning over.

At night I asked my father about it, and he agreed with Bings that I was not strong enough to do the trick. But after supper I went out, hitched up the foot-power rig on the grindstone, and *ground that scythe*, and I ground it till it was sharp. Then I mowed a little to see how it felt, hung up my scythe, and went to bed.

In the morning I was late, so late that Bings did not have the patience to wait for me to turn the grindstone, so he ground up by foot power. I got out just in time to fall in back of him and take a little good natured bantering about my weak back, but I hung right on that

chap's heels all day. I ground my scythe myself about half way between his grindings, and if my back did ache I'll bet his did too.

I have used all this space to tell this story because it was in this way that I learned something that at least seventy-nine million out of the eighty million people in this country do not know. That is, *I learned to act for myself.* I learned that if I wanted to do a thing, nobody's opinion as to the feasibility of it was half as good as my own, and that if I wanted to have another man work for me to advantage I must let him work in his own way. You, and every other man who reads this page, were born with some degree of individuality; it is your right and, if you would amount to anything, a necessity, that you should work out your own way according as that individuality leads you. You can never amount to anything by doing what your neighbor does by mere imitation.

In the next breath I want to say that if you would work successfully for any man you must study his individuality and, so far as you can, merge your own in his. If yours is the stronger, and you are possessed of tact, you will dominate him. Probably the most comfortable position in the world is to be the power behind the throne; and this is the place where tact and a judicious use of initiative, which is only active individuality, can land you. If you are a young man only starting in the world of employment, you will have to cultivate your individuality under cover till time has convinced your employer that you are "safe;" then there is no employer but will welcome the time when he may put you on a job and go away in confidence that when he comes back he will find it done, instead of finding you, with a lot of excuses, sitting down to wait for someone else to do a part which the least bit of tact on your part would have made him glad to do.

The other thing I might get out of this story is an illustration of what sort of a show a boy has in a shop where no one wants or intends to teach him if he can help it; but your readers must be tired of hearing me harp on that string, so I will drop it. ENTROPY.

Using Everything

I was visiting in south Georgia recently and became interested in cotton-oil mills. One finds sometimes in connection with them the old-fashioned darky fireman, such as I found on visiting the boiler-room. He began the conversation:

"Lawd, boss, dese wite foks shore am gittin' savin'. Ah 'members when dev uster take dese yeah cotton seed, make us niggers hawl 'em off, trow 'em on de groun' somewhar ter git 'em outen de way. But jes' look wat dey does now! Dey brings 'em yeah an' runs 'em tru dis gin; dey takes dat lint an' makes yer close outen it; den dey takes dem seeds an' dey taks 'em bak dar an' cooks 'em, bless goodness, cook 'em! An' puts 'em in de huller an' taks all de hull offen 'em; den dey tak an' stew 'em up, put 'em in dat press an' squiz all de ile outen 'em; taks dat ile an' maks yer lard an' butter an' all dem t'ings, — an' — whar 'd' yer say you's frum?"

"Up North, Uncle Jake," say I.

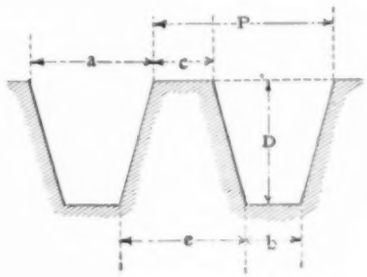
"Waal—dey's a man down yeah frum up dar somears, an' he done tak his rule an' measure dis yeah chimbley, an' bress de Lawd! he said he gwine ketch dat smoke. Law, Law, Law!" I. L. D.

The Brown & Sharpe 29-degree Worm Thread and the Acme Standard Screw Thread

Very recently, in connection with inspection work on ordnance material for the U. S. army, I was rather surprised to notice the confusion that exists in the mind of some mechanics regarding the 29-degree Acme Standard Screw Thread and the Brown & Sharpe 20-degree worm thread, and it is with the idea of clearing up such confusion as far as possible that this is written.

The accompanying sketches and formulas show plainly, by comparison, the great difference between threads of the same pitch in the two systems. Figs. 1 and 2 are sectional views of threads of one-inch linear pitch drawn to scale to the proportions given by the thread formulas following, and show graphically the difference above mentioned.

The formulas are practically the same

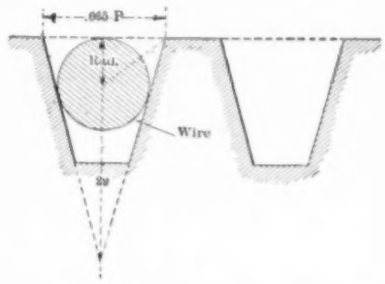


Formulas
P = Linear Pitch
D = .6866 P
a = .065 P
b = .31 P
c = .335 P
e = .09 P

FIG. 1. B. & S. 29-DEGREE WORM THREAD

as are given in literature issued by the Brown & Sharpe Manufacturing Company.

The scheme for measuring the diameter of screws in the thread angle by means of a wire laid in the groove, and an ordinary micrometer caliper, as described by me at page 904, Vol. 26, is as easily applied to the Brown & Sharpe 29-degree worm thread, as to the Acme 29-degree thread, dealt with in the issue above mentioned. The diameter of wire for each pitch that will rest in the thread groove

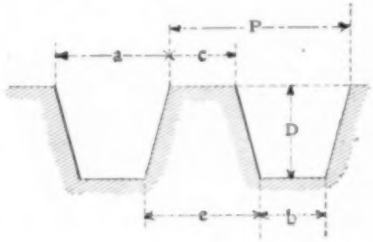


Pitch	Wire Diam. for given Pitches Wire Diam.
2"	1.0298
1¾"	0.9010
1½"	0.7723
1¼"	0.6436
1"	0.5149
⅞"	0.3862
¾"	0.2574
⅝"	0.1716
½"	0.1287
⅜"	0.1030
⅓"	0.0858
⅜"	0.0735
⅛"	0.0643

TABLE OF WIRE SIZES FOR MEASURING B. & S. 29-DEGREE WORM THREADS

on the thread angle and be flush with the tops of the finished threads is found as follows:

Rad. of wire section (see table) = side opp. = side adj. × tan. 37 degrees 45 minutes = $\frac{0.665\ P}{2} \times 0.77428 = 0.257448\ P$ and diam. of wire = $0.5149\ P$.



Formulas
P = Linear Pitch
D = .5 P + 0.01
a = .6203 P
b = .3707 P − 0.0062
c = .3707 P
e = .6345 P

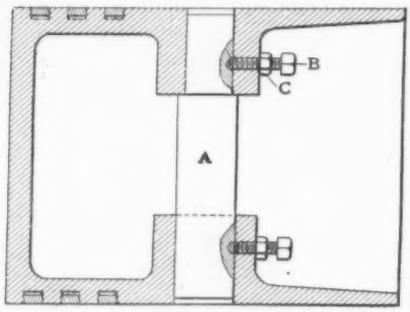
FIG. 2. 29-DEGREE ACME SCREW THREAD

The above should effectually clear up the confusion spoken of, and also be of assistance to anyone who may have the job of cutting the 29-degree worm thread.

WALTER CANTELO.

Fastening a Wrist Pin in a Piston

At page 455 there were shown a number of ways of fastening the wrist pin in the piston. I think that one of the best and simplest methods was omitted.



WAY OF HOLDING WRIST PIN

It is as follows: Bore a straight hole in both pin bosses, but bore the hole in one boss 1-16 inch smaller than in the other. Fit the pin *A* to these holes, and it is held from moving in one direction by the shoulder on it. Each boss is drilled and tapped for a set screw and they are spotted deeply into the wrist pin. If the pin is properly fitted and the set screws *B* and their lock nuts *C* are well set up, one need have no fear of its working loose. W. ALTON

Keeping Tabs on Stock Steel

It sometimes happens that a tap, reamer, milling-machine cutter or other tool is made from "machinery" steel when the party intended using tool steel; and in consequence the article is thrown away and another made in its place, or an attempt is made to harden it and get something out of it.

It is possible to harden tools made from low-grade steel, provided the stock is suitable, and get considerable wear out of them; but that is not along the line I intended writing when I started, and so I will reserve that for another time.

Stock should be kept in such a manner that the various kinds and grades can be easily recognized. In many shops the tool steel of all makes and tempers is kept in one pile on the floor, and many times the various qualities of low-grade steel are kept in the same pile. As a consequence it is impossible to tell the various brands and tempers apart after the makers' marks are cut away or obliterated.

The appearance of the surface of most low-grade steel is so different from that of tool steel that it is an easy matter to tell them apart, even though the tags or other distinguishing marks are cut away. I say it is easy to tell them apart, by which I mean it is generally an easy matter for one versed in the appearance of each; but I have seen good workmen who could not tell by the appearance of the surface which was which, and I have seen bars of steel that an experienced man could not tell by looking at the surface.

As a rule low-grade steel is subjected to a high heat in the rolling mill and this causes the surface to scale. This scale is heavy and broken. Tool steel is finished at low heats and the scale is thin and smooth. However, this rule is sometimes departed from. I have seen low-grade steel whose surface scale was smooth and glossy, as I have seen tool steel whose surface was not as smooth as some "machinery" steel; so the rule does not always hold good.

I have seen mechanics, when in doubt as to the kind of steel, chip off a piece, heat it red hot, plunge it into water, then test it with a file to see if it was hard. A good many years ago this test would have sufficed, but today bessemer and open-hearth steel are both made with varying carbon content; and if they contain a sufficient amount of this element, they will harden as readily as tool steel, and will test as hard with the file. Yet, unless they are low in harmful impurities, they would not prove strong enough for cutting tools, and when delicate tools for hard usage are to be made, such steel would not answer.

From the above it is apparent that our different kinds and makes of steel should be kept separate from each other, or they should be so distinctly marked that there will be no possibility of their being mixed. I have always insisted on having my tool steel stamped with the name of the maker, or the particular brand of steel, near the center of the bar, and then having it cut from each end, so the st ed portion would be the last part o bar to be given out. Then, again, .e steel was made for a certain purpose with a carbon content different from the ordinary amount in use in our shop, or it contained a certain amount of tungsten or other element not generally present in the steel used, this was stamped on the bar also. The cost ticket that accompanied the steel through the various operations had on it the make of the steel and any distinguishing mark on the bar. In this way we were able to give the steel any peculiar treatment necessary when it was hardened.

A few days ago I had made from "machinery" steel several screws which were case-hardened. When turned to place, two of them broke, and, when tested with a file, they proved hard all through. The balance were annealed and used soft. We cut another piece from the bar, heated it red hot, plunged it in water, and it proved hard. This was bought for bessemer steel and the surface had every indication of low-grade steel. Under test a second piece, which was hardened at a low red, showed extremely weak and, when tested for strength, broke very much more easily than a piece of crucible tool steel of the same size, which was hardened at the same heat and under the same conditions.

I think most up-to-date shops are careful regarding the subject under consideration, but I see many cases where many dollars might have been saved had the parties been exercising proper care. It is possible to select steel for various purposes and get much greater returns from money invested in machinery, tools and wages paid than if one brand is used for all purposes. In such cases it is absolutely necessary to "keep tabs on the stock." E. R. MARKHAM.

Phosphor-Bronze Springs

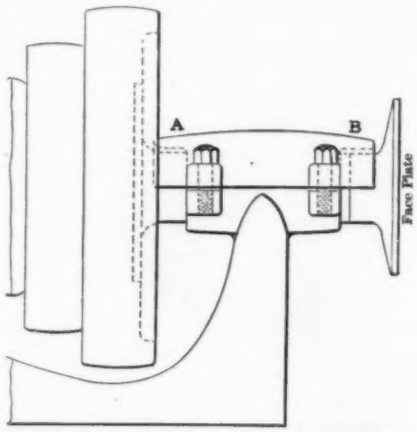
Phosphor-bronze wire is being used for springs to seat pump valves and elsewhere in water, steel being unsuitable owing to rapid corrosion. An instance recently occurred where hard drawn brass wire had been used satisfactorily for some years for this class of service, and a change was made to the more modern, and thought to be more efficient, material. The springs when fitted failed after very short usage, and as this caused much annoyance and involved a serious loss to the firm concerned, the material formerly used was again resorted to.

Upon inquiring in other quarters, the fact came to light that phosphor-bronze wire is not an altogether reliable material for springs. Users who have bought experience by failure, test each parcel of wire as delivered, by having a piece made up into an open coil short spring of definite length and closing it repeatedly. Any permanent set resulting, the material is returned to the makers. A. L. HAAS.

London, England.

Combination Cap and Oil Guard for the Wood Lathe

One of the greatest nuisances in a wood working shop is the wood lathe that has



COMBINATION CAP AND OIL GUARD FOR THE WOOD LATHE

no shield over the bearings to prevent the oil from covering the operator. It is not a pleasant thing to start work with a clean shirt and jacket, and after an hour or two have them covered with oil. A little thought when designing could prevent this nuisance.

I have replaced the regular caps on our wood lathes with the caps shown in the sketch herewith; the overlapping parts *A B* extending far enough out to act as shields. M.

Unjust Claims upon Builders of Machine Tools

I was much interested in the editorial at page 756, Vol. 29, Part 2, because some years ago a company tried to use me as a tool in their schemes. They had just installed a large boring mill, and for some reason unknown to me, they had changed their mind between the time of ordering and installing, and decided they wanted another make. I was at that time employed as a boring-mill hand in the shop, and was put on the new mill with instructions to "keep the belts tight and tear the guts out of her." This I did to the full extent of the steel tools I was provided with, but the machine took the heaviest and fastest cuts the steel on hand would stand up for, so some different grades were bought, and for two weeks I had great fun snapping off tools 1 to 1½ inches square. After trying this until they got tired, they told me to belt the machine up to a pulley which would make the table spin around like a top when on the high speed. This done I was told to let her run *without oil* until the table was so hot that one's hand could not be held on it. By this time I began to suspect that something more than a fair test of the mill was being made, and I was not altogether surprised, as the company did not treat its employees as fairly as some I have worked for. After three hours' running the table got quite warm and the belt refused to drive it, so the gears were thrown in and she was kept going until I was beginning to look for melted babbitt in the pit. A telegram was sent to the builders that the machine was almost useless and the next day their man arrived. He inquired into the matter and saw at once that the trouble did not lie in the tool, but asked to see some tests. The first in order was to lift the table off and show the condition of the bearing surfaces (now flooded with oil). The man at once told them that it had been running dry but this they denied. Then a large steel wheel was put on and a heavy fast cut started, my instructions being to stick her or get fired; this I proceeded to do as long as the manager stood around, but the minute his back was turned I told the builder's man just what was up, first getting his promise not to implicate me. I was sick of the whole matter and when the manager brought out a speed indicator held it on the edge of the table and read off the speed I knew he was lying, and openly advised the builder's man to get an instrument which had not been tampered with and try it himself. Of course I was fired about ten minutes later, but I cannot remember an instance of that nature where I felt so genuinely glad to get out. I do not know to this day whether the mill is in that shop or not, and if I ever visit the town I will certainly look it up, if just for old times' sake.

Canada. W. L. McLaren.

As you have invited a discussion on the subject of unjust claims upon builders of machine tools, I submit the following as my opinion of the evil, and its ultimate eradication. Your article stated that the buyers and users of machine tools are supposed to know how to handle them properly; but do they? Now a buyer of a machine tool naturally wants the latest and best model or design; in fact, he wants the very best he can afford. There are extensive improvements in machine tools from time to time, and as a practical shop man is supposed to spend most or all of his time in the shop, he has little chance to keep posted on all of these improvements, unless he is an extensive reader of mechanical papers. The average machinist, we believe, is not. Another source of his information is catalogs, which, for him, are hard to get, and at best are of little educational value to him. They tell what certain machines will do, but not *how they do it*. They give a very pretty picture of the outside of the machine, but that is all; and the man that sets the machine up and starts it has to either take it all apart or try experiments, which are sometimes very expensive to the buyer, and in some cases to the builder. You will not find a man in the shop, where a new machine has been put in, that is satisfied until he knows just how that machine works, and to educate the men costs the proprietor quite a sum in time. The remedy for this is *more information* from the builder as to the workings of his machine and details of the parts, together with blue prints, specifications, cuts, and full and explicit directions for installing and operating.

We build a machine and outfits for making seamless gold-tooth crowns, that go all over the world, and are supposed to go into hands of educated and practical men. But I found it was useless to try to introduce a new machine and method without the above instructions, which have proved so satisfactory that we could not get along without them. Treat the buyer as the correspondence schools treat the students —as though he knew nothing. You will find that the average mechanic will not acknowledge that he does not know all about a new machine, but will make a bluff at it, and generally gets off with it all right; but there are times when his bluff won't work, and those are the times that it costs someone some money. The seller should send to the buyer by registered mail full instructions to be gone over carefully, and given to the man that is to handle the machine. A duplicate set should also go with the machine. The seller should warn the buyer that he will not be responsible for any ignorance nor liable for damages, unless the instructions have been carried out to the letter. These instructions for machine tools should include speeds for counter-shafts, methods of installing, proper materials and foundations, description of all levers, gears, cams, and in fact everything that the builder has found to be necessary in properly handling the machine. Then there is no excuse whatever for any kick, unless there are defects in the machine, which sometimes occur in the best of shops. I would like to see this plan tried in the machine-tool line, as I am confident it would prove of great benefit to both the buyer and seller. E. D. Craig.

Delaware.

Since you ask for a discussion of the machine-tool builders' problem at page 756, Vol. 29, Part 2, and since I have been up against this same problem for a generous share of my life, it may do no harm for me to set down here some of the things which seem to me to have an influence on the matter.

To get to the bottom of the difficulty we must remember that there is a great difference of opinion as to whether a machine tool is a permanent investment like a building, or whether it is an article of consumption like files and emery wheels. If the first is true, then a machine tool should be so designed and built that it may last indefinitely with a minimum of repairs. If the second is true, then the machine should produce the greatest amount of acceptable work in a given time, which should be that in which the process of evolution may be expected to produce another tool of such efficiency as to make it unwise to run the first one longer. The difference of opinion on this point has led to the building of machinery of every possible degree of accuracy and of every possible design. This is what makes it hard for a manufacturer to know whether his tools will stay sold or not. A man who wishes to buy a lathe will write to every advertiser in your columns, perhaps. He will get bids ranging up to three or four times the lowest bid. He knows that the lowest-priced machine cannot be best, but he probably has not money enough to buy the best, or he may feel like a friend of mine, who said that if he had enough money to buy a certain make of tool he would invest it and live on his income without working. What our purchaser will probably do will be to pick out a machine at random, or practically so; that is, he will be more influenced by the personality of the salesman than by any question of real merit. If, when he gets the tool, it is in any degree better than he expected, the tool stays sold; if it is worse, even a dollar's worth, he is dissatisfied and at least makes things unpleasant.

In order to establish a working basis, there must be some way of grading tools

so that a man not skilled in their manufacture may have some way of rating a tool so that he may specify in his order exactly what he wants. Once accomplish that, and purchaser and seller can settle their disagreement by reference to an expert, who can say whether specifications are met or not. Or, if the manufacturer preferred, he could furnish with the tool a certificate as to these specifications, made by a disinterested party. Such a course would make it possible and necessary for a tool to be accepted or rejected before it became second-hand.

It would also help in such cases as one to which I have been a witness lately. Over here, in the shop across the way, they have just put in two lathes. One is a little dandy, uniformly polished where it should be polished, nicely fitted, and painted where it should be painted. It looks just right. The other is as ungainly a pup as ever stood on four legs. The two lathes are doing precisely the same amount of work, so far as I can see, but the chap that is running the second one is the most disgruntled man in the shop. The foreman told him that it was no good before it was belted up, and he keeps on telling him so now. More than that, he tells other people so, and he tells the superintendent so. In this particular case the superintendent knows enough about a lathe to judge for himself, so the lathe will stay; but if he were like a large percentage of superintendents, this steady complaining would wear on his nerves till he was ready to try to work it off on the manufacturer. In this case there is no well defined trouble; but if the men in the shop dared to make it, there would be. It is easy enough to put a tool out of commission in such a way as to make it hard to tell whether it was done after it left the builder's shop or before.

A REMEDY

There is one general remedy in use now which is good if it is not abused, and which the following incident will illustrate. I had an inquiry from the Blank Manufacturing Company which I was to follow up. On the way down there I ran across a man who was selling for a dealer. I asked him about the company to which I was going. He told me not to sell them anything. "Why," he said, "they had three Brown & Sharpe milling machines there before they found one that they would accept."

When I got there the superintendent took me out through the shop, and we went past a row of machines built by a concern whose name in that region is a synonym for good design and perfect workmanship. "People think these are great machines," he said, "but that is a tough lot. And more than that, they won't make them good." I sized up the situation and when it came time to name prices mine was 20 per cent. higher than I had meant to name. I figured that there would be something wrong with our machine and I wanted a hundred or two to spare. Well, there was something the matter, but it only cost us about $15 to straighten it out, so there was a good profit. Now why did they stand this raise? Simply because they had to. Every dealer had probably done the same thing that I did, and my house was the only one they wrote to that was near enough to chase up the matter themselves.

There is a sort of freemasonry among salesmen that takes care of chronic cases of this sort. But suppose that some dealer had bid on our tool and received the order. Would he have stood the cost of these changes which he knew we would have to make? No, he wouldn't. He would have come back on us and pocketed his extra price. Worse than that is the possibility that some unscrupulous dealer will spread adverse reports, so as to keep others away and keep all the trade to himself. And even worse than that is the possibility that a dealer may stand in with a customer to get him a rebate from the manufacturer rather than have the machine made right by the builder.

This illustrates two things which I think will be necessary to solve this question. One is the "money back" plan of doing business, and the other is that manufacturers should have the privilege of turning down dealers' orders for sales to undesirable customers. The "Money-back" plan necessitates raising prices enough to make a sort of general insurance fund. It would work hardship on the fair minded user for the benefit of the unscrupulous, but if every manufacturer had the privilege of passing on the sales of his dealers, the unscrupulous user would soon be barred from buying anything. The "money back" proposition would mean that the standard of excellence would be pretty closely related to price. A user would say, "Here, I can buy the North Pole Company's lathe for $400 and the South Pole Company charge $600. I will buy one of the North Pole lathes, and if it will test up to my needs I will keep it; if not, I will send it back and get a South Pole lathe. But I will see that the first lathe gets a show because, I want to save $200; and I know the the North Pole people will take the lathe back rather than fool around trying to make it suit me, because they have set the price high enough so they can afford it."

ENTROPY.

Your article at page 756, Vol. 29, Part 2, chiefly refers to damage caused to machinery in shipping or setting up, but I assure you quite a long story could be written on the "Use and Abuse of a Machine" after it has been fixed and put in running order, by falling to the tender mercies of incompetent operators.

I give two instances of what I myself have seen. They are enough to make builders of machine tools turn in their graves.

A fellow running a Prentice lathe next to me missed his driving plate one morning, and the usual hunt and language (more forcible than polite) followed. Eventually it was found—yes—found wabbling on the spindle of a Reed lathe, which, by the way, has a thread of an entirely different pitch. Yet it was jammed on so tightly that it was only with difficulty removed. I have since been wondering if, when he uses his face plate and it runs out, he will blame himself or the lathe.

Another instance was where a young fellow was facing out the shoulder on a small collar bushing, and every time he put a piece on the arbor he would knock the arbor on the lathe bed until it was on tight enough. To remove the piece, the lathe received similar treatment from the other end of the arbor; and, though you may not credit it, he actually hammered it on the V-slides. I casually ventured the remark to him that it would not improve the lathe any, but it was met with no thanks. He deliberately took a file, and in a cold-blooded manner filed off the burs, and went on as if nothing unusual had happened.

Most lathes I have worked on bear marks of treatment of which surely any mechanic of ordinary intelligence would not be guilty.

B. P.

Opportunities in the Machinists' Trade

We hear a great deal nowadays about the reasons why boys do not enter the shops, and many writers tell us that there is no longer any opportunity sufficient to attract bright young men to the shop.

I believe this statement is incorrect, at least so far as many shops are concerned. While there may be many manufacturing establishments where the operator is almost a part of his machine, there are also hundreds of others where he will get enough variety of work to satisfy him.

I believe there was never a time when there was a greater demand for first-class mechanics than now, and any foreman will say that he cannot get enough first-class men; for where one man who is capable of thinking for himself can be found there are 10 who will fall down and cry for help the moment they are thrown on their own resources.

An incident which came to my notice not long ago illustrates this statement. It was almost quitting time at the little automobile-repair shop and we were getting ready to go home, when the telephone rang and we got word that a machine was stuck 10 miles out in the country with three bolts broken or lost from the steering gear. The chauffeur in charge had been a machinist before he began to run au-

tomobiles, and one of the men with him had been an operator for over a year; but both said they had nothing with them with which they could make repairs.

We got three bolts and, as no other messenger was available, a young pattern-maker in our employment offered to ride out on his bicycle with them. It was long after dark when he got there, and then he found the bolts he had brought could not be used. He looked in their tool box and found three that would go in, but were about 1½ inches too long. Then he took a piece of their spare chain, which was of the detachable roller type, knocked it apart and used the rollers as washers to take up the extra length on the bolts. In about half an hour he had repaired the machine so it could be brought in, and used the very means that the three men who were riding on the machine had at hand and did not think of using.

Boys like the above will have no occasion to complain of lack of opportunity.

W. ALTON.

A Novel Planer in a New England Shop

The Whitcomb-Blaisdell Company has a novel planer in its shops in Worcester for planing the housings or posts of its planers. The half-tone Fig. 1 shows that it is a short, wide, "squatty" machine with all unnecessary parts left off. The cross rail is mounted at a fixed hight above a short table on which there is a second table mounted so that it is movable about a central pin. They use it as indicated in Fig. 2, putting on two housings at once back to back, planing the two faces first and then turning the table through 90 degrees and planing the base of the post where it bolts to the cheek of the bed. Putting the two on in this way it will be seen that they have a check on the squareness of the planing, for if there was the slightest variation from a right angle when the housings were in place on the planer they would be out of parallel twice the amount of the error, which would show plainly when a straight edge was put across them. If they put the housings on the planer as indicated by *a a*, Fig. 2, they might be out by a considerable amount without showing.

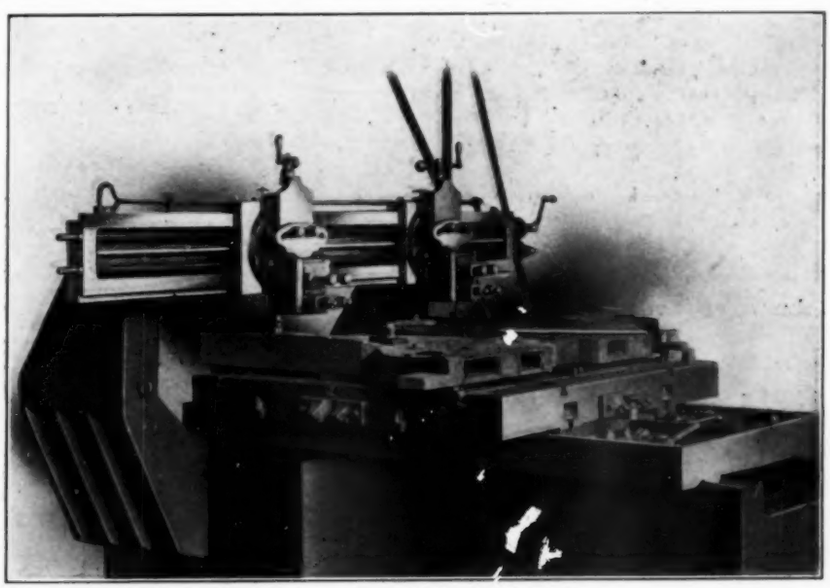


FIG. 1. GENERAL VIEW OF PLANER

OPERATION OF THE TABLE

To set the planer table to turn exactly 90 degrees the plug at *A* and the ears *B B B B* of Fig. 2 are used. Plug *A* fits nicely in the lower table but still free enough so that it can be pulled out to shift the setting. Set screws at *c* and *d* bear against this plug and serve to adjust the position of the table. One set screw has a lock nut, and once set is not disturbed unless it becomes necessary to re-adjust the machine. To move the table, the other set screw is loosened and the plug pulled out, then a man with a bar in one of the slots pulls the table around. The eye bolt shown in the near housing in Fig. 1 was put in with the idea of pulling the table around by a chain attached to the front of the table and hooked to this bolt; but so far it has been easier to pull it around by main force.

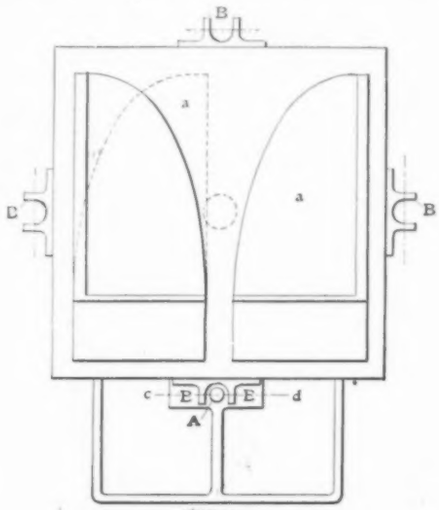


FIG. 2

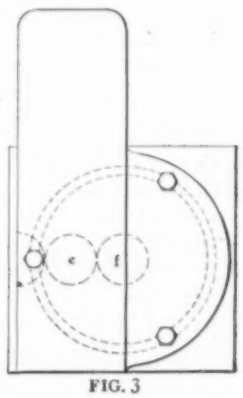


FIG. 3

PLANER TABLE AND HEAD

30-INCH PLANER WITH TWO HEADS

Some ten years ago or more I bought a 30-inch planer of these same people and had it built with two heads offset as much as possible, to get the tools close together. At that time every other planer builder to whom I went tried to laugh me out of it, two heads on a planer of that size being an absurdity and even these people seemed to think the request rather odd. What, then, was my surprise to find that this is now a regular thing and that they have gone me one better and built a special offset head.

THE OFFSET HEAD

The idea is outlined in Fig. 3 where *e* and *f* are two spur gears. Back of *f* is a pair of miter gears gearing on to the cross-feed rod in the cross rail, and in front of *e* is a similar pair gearing on to the down-feed screw. This two- or three-inch gain on each tool toward the other is so useful, and the means of getting it so simple, that it seems strange that no one else has thought of it. I had an idea once of feeding the head down by just the same means as is used on a boring mill, that is, a worm and gear in the cross rail and a rack and pinion on the sliding head; but it was going to necessitate counterbalancing the heads, and was too much of an innovation to be safe to place on the market, so I dropped it. This scheme seems to fill the bill, and it is not enough different from the regular thing so that any customer need be afraid of it.

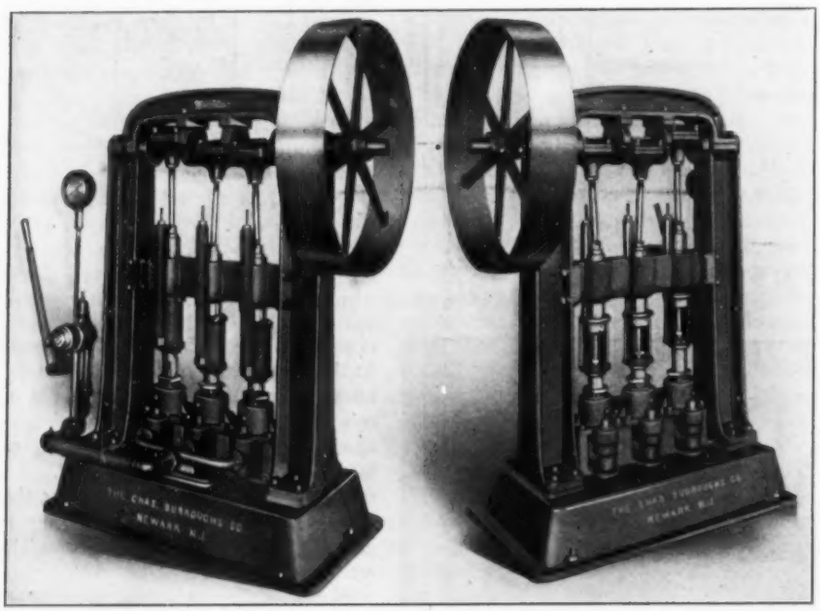
ENTROPY.

Hydraulic Presses and Pumps

In the manufacture of a large variety of articles in everyday use, the hydraulic press and its attendant pump play an important part. For the embossing of thin metal or plastic substances at a few pounds pressure, or the hubbing of dies for jewelers and medal makers at a pressure of many tons, the hydraulic press is readily available.

THE HYDRAULIC PUMP

The principal objection to hydraulic presses has been their lack of speed where high pressures were demanded. Of course, other things being equal, the greater the pressure required the smaller the ram used, and a consequent lack of speed is the result. This lack of speed was not objected to when actually applying the high pressures to the work, but in getting ready, taking up the slack, as it were, between the ram and the plates, or between the dies. This has been overcome in various ways by having a low-pressure pump with large ram to bring the press ram up to contact with the dies or other work and then shutting it off, and proceeding with the actual work with the slow-speed, high-pressure ram. The change from the fast-speed, low-pressure pump to the slow-speed, high-pressure pump has been accomplished in many ways, some by hand and some automatically: some saved little or no time, some were great time savers, but all were more or less cumbersome. As a general thing, each pump chamber had one inlet and one outlet valve. Among the automatic devices one was operated by a complex arrangement of levers in the tank in the base of the pump; these lifted the suction valve of the low-pressure pump.



FIGS. 1 AND 2. FRONT AND REAR VIEWS OF THE PUMP

The pump shown in Figs. 1 and 2 has a novel arrangement of high- and low-pressure plungers. Referring to Fig. 2 which is the rear view of the pump, it will be noted that there are three pump cylinders. In these three cylinders are three large plungers, and inside these large plungers are three small plungers. The connecting rods reach from the cranks above to the small pistons below. The tops of the small pistons are provided with nuts. On the up stroke, these nuts bear against a yoke connected with the large plungers and lift them. The large plungers are forced down by compression springs contained in the tubes at the front of the machine, which are shown in Fig. 1. When the pressure in the press overcomes the pressure of these springs, the large plunger stops automatically at top position, shown by the large plunger at the right in Fig. 2; the pressure under the plunger keeps it there. The small high-pressure plunger keeps on working until the desired pressure is obtained. In the hand pump, Fig. 3, the springs for the large plunger are tension springs and are not inclosed. In a test of the power pump I saw the press ram moved two inches by the large low-pressure rams in three seconds; and in less than two seconds after the change to high pressure the gage showed 50 tons pressure.

In the pump shown there is but one suction and one delivery valve for each pair of pumps; thus there are only three suction and three delivery valves for the entire pump. Owing to the large size of these valves, it is difficult or impossible to keep the caps or bonnets tight when under high pressure by employing the old method of a taper seat for the bonnet. The method of keeping the bonnets tight is an adaptation of the hydraulic fitting shown at Fig. 4. It is made with a recess *A* in which there is a lead ring. This lead ring, after the pipe is screwed up tight, is compressed by a set screw *B* in a radial hole connecting with the groove, and forced into close contact with the threads of the pipe and the groove in the fitting.

The joint used on the valve bonnet is just the opposite of this. It is shown to the right in Fig. 4, the lead filling being left out in the sketch to show the construction. *C* is the top of the pump cylinder into which the bonnet *D* is screwed. The annular groove *E* is for

FIG. 3. A HAND PUMP

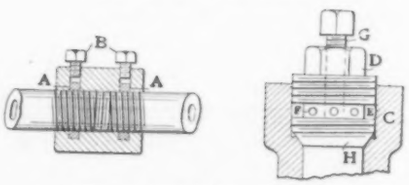


FIG. 4. THE VALVE BONNET

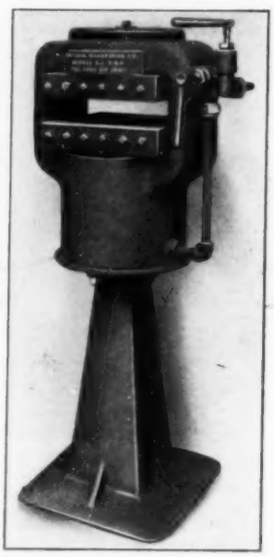


FIG. 5. A SMALL 100-TON PRESS

the lead; radial holes *F* connect the groove with the hole in the center for the set screw *G*. Screwing the set screw *G* down forces the lead through the radial holes *F* and makes an absolutely tight joint between the bonnet and the body. By using this form of joint, no dependence need be placed on the tapered seat at *H*, which is usually relied on to be water tight.

THE HYDRAULIC PRESS

Figs. 5 and 6 show two hydraulic presses. Those presses are by virtue of their extreme simplicity odd. They consist of but three main parts—the cylinder, plunger, and top platen. The main body of the steel casting contains the cylinder, the cheeks and the seat for the platen. This allows the two cheeks to be brought as close as possible to the strains, and avoids

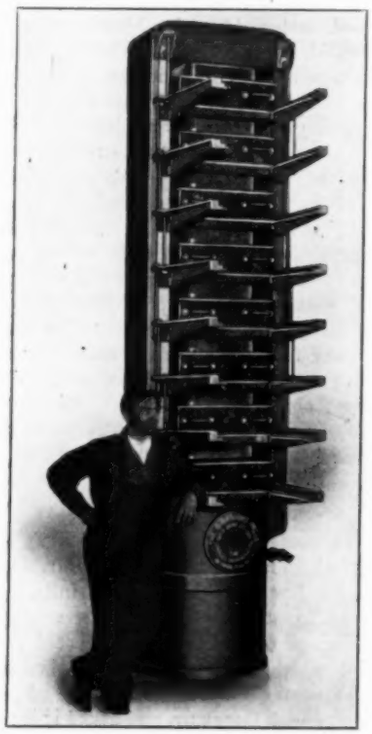


FIG. 6. A 760-TON PRESS

the overhang necessary when side rods are used. The face, where the top platen seats, is easily machined square with the ram and it remains square, as there are no threaded rods to stretch and give trouble. These presses are built with any size of platen, of any hight and for any pressure. Fig. 5 has a platen 14x14 inches and is capable of 100 tons pressure. Fig. 6 has a platen 16 inches square and is capable of 760 tons pressure. It weighs 4000 pounds less than a similar press with side rods, and yet the cheeks are about six times as strong as rods would be.

These pumps and presses are built by the Charles Burroughs Company, 141 to 149 Commerce street, Newark, N. J.

THE WEAK POINT IN OUR SYSTEMS OF INDUSTRIAL EDUCATION

Discussion of the A. S. M. E. Paper, "A Plan to Provide for a Supply of Skilled Workmen," by M. A. Alexander

BY H. F. J. PORTER

It is very necessary for us to understand that the motive for giving shop instruction to our workmen is not by any means philanthropic in its nature. It is, on the contrary, solely a business one, for the purpose of strengthening our working organization that we may get from it a better and cheaper workmanship.

HOLDING GRADUATES

But, to accomplish these results, I think I can show that we must not only educate our employees, but *we must try to hold them in our service afterward;* for it is perfectly evident that, if after we have educated them they go elsewhere, our efforts to improve our working conditions have been futile; and should they go to a competitor, we have actually spent money to our own business detriment. I do not think that the General Electric Company has sufficiently emphasized this point in its curriculum, for although (in paragraph 41) Mr. Alexander states that it encourages its apprentices to remain in its service, still further on (in paragraphs 42 and 43) he shows that nevertheless there is a strong tendency for them to leave; in fact, a very large percentage do leave. It seems to me that these boys should all understand that they are in line for advancement to better places than they could hope for elsewhere, and that if they go away they will lose their turn. I fear that Mr. Alexander's wish is father to the thought that those who leave will return, but the probabilities are as great that they will not; nor will it do for him to excuse this defect in the system by saying that they will be benefited by rubbing up against the world. If he has taught them the best way to do things, it ought not to be supposed that they will find any better way outside, while on the contrary, they will see many ways which are worse; so that, with their lack of experience and at their impressionable age, if they do come back they will have learned nothing good and a great deal that is bad.

EDUCATION IS EXPENSIVE

Now, we know that education is a very expensive luxury. This is shown by the appeals made by our educational institutions all over the country for funds to help them carry on their work. So that it is quite possible that a manufacturing enterprise may go into an elaborate system of industrial education and find that the latter would not only fail to accomplish what is desired, but might actually involve the company in financial difficulties by the attendant expense, especially when it is working on the small margin of profit which the close competition of the day makes necessary.

I want now to give some evidence which will bear me out in my assertion that manufacturing concerns are not accomplishing what they are striving for by simply establishing in their shops apprenticeship systems or other systems of educating their employees. I shall mention a few concrete instances which have come under my own observation, as examples.

EXAMPLES—A PITTSBURG WORKS

In certain works in Pittsburg, of which I have some knowledge, there had been a large financial loss for several years, owing to poor business management on the one hand, and an inferior class of employees on the other. Under a new business administration, improved working conditions were introduced with the result that a better class of employees was attracted there. Now, these works were dominated by the same interests which controlled very much larger works near by, where an expensive apprenticeship system had been instituted and kept running for several years.

Under the conditions established by the new management in the smaller works the attraction became so strong that employees from the larger works were drawn there, which brought a protest from the management against taking away the graduates of their apprenticeship system. The opportunities for advancement were so superior in the smaller works that they acted as an allurement which the larger works had provided nothing to offset. In fact, it was the policy of the latter establishment to fill its best positions from outside sources instead of from its own organization. The effect of this policy was to destroy all hope of advancement among its employees, and everyone who had any ambition to better himself went elsewhere as soon as he got his equipment. I had previously heard that these works were educating mechanics for other concerns all over the country, and I then had the evidence presented to me at first hand. No effort was subsequently made to close the gates at the larger works, and the exodus went on as merrily as ever; so that the only effect of the protest was to preclude the smaller works from enjoying their share of the benefit.

A PHILADELPHIA CASE

In certain works near Philadelphia, of

which I have more recent knowledge, a slightly different condition existed. The works were situated in a beautiful suburban district, the wealthy residents of which did not want a factory nor workmen's houses located near them, nor did they want any trolley lines in their vicinity. The result was that the workmen, in order to reach the works at 7 o'clock in the morning, had to rise at 5 o'clock, and sometimes stand up in the cars for three or four miles, and then walk a mile and a half from the nearest trolley, and steam railway. So that they had actually done a half day's work before they started in at the factory.

Good mechanics could get work elsewhere which did not entail such inconvenience of access; consequently it was only an inferior class of workmen who could be persuaded to go there. Now these men had to be educated after they went there in order to perform their work satisfactorily, but it was found that they stayed only long enough to acquire sufficient knowledge to equip them to enter other works of the same kind in the city proper. In fact, it got to be known as a feeder for some large locomotive works there.

I happened to be at these works for the first time last Easter Monday. Now Easter in Pennsylvania is a notable festival, the effects of which often last over till the next day, and when I arrived at the works in the morning with the manager, the superintendent greeted us by saying that he thought he had better shut the works down for the day as there were too few men present to run them economically, and that many of those were not in a fit condition to work. There were then 98 men in the organization and 36 per cent. were absent.

Since that time working conditions have been made more attractive there. Transportation facilities have been secured. Workmen's houses of an inexpensive but adequate character have been made available, and a club-house has been opened. At the present time, there are 210 men in the organization, and last week the day after Thanksgiving, a genuine holiday, only 6 per cent. were absent. Several of the absentees were away by permission, and there was no evidence that those present were not fit to do their full duty. In other words, in six months this organization had increased more than 100 per cent., and the absentee question was no longer a live issue. I mention this incident to show the effect of a change in management on the character of the organization. It is not necessary now to maintain the system of education previously established. The helpful features of the place are strong enough not only to bring back old hands who had been educated there, but to attract graduates of apprenticeship systems of other works as well. These men are good enough mechanics for the work in hand, and they stay.

A NEW YORK INSTANCE

Again, take certain works in this city with which I am familiar. The proprietor this fall told me that it was very difficult to get good workmen, that the labor market in New York City contained only floaters, all the good mechanics going to the nearby manufacturing towns. I told him I thought that if his inducements were strong enough he would have no trouble in getting as good mechanics as he wanted. He asked me to visit the plant, which I did. The manager there told me that he had an average loss from his organization per month of 15 per cent., or 180 per cent. a year. He said there were 700 men in the organization, and that that many had entered and left the works during the summer months alone. Now every one of the workmen who came there had to be educated more or less to do the special work in which the plant was engaged, all of which was being lost to it, the benefit going to others. Changes were at once instituted in the character of the management which are now rapidly reducing the percentage of losses.

STILL ANOTHER CASE

A large and representative plant, of which you all have knowledge, and which is represented here this evening, has over 4100 men employed. It has an apprenticeship system which has been described in the magazines as being very advanced and complete, and which, I have no doubt, ranks with the system at the Lynn works, of which we have just heard. My information of conditions there is as recent as last week, when one of the officials told me that the percentage of loss of employees is from 8 to 10 per cent. per month, or up to 120 per cent. per year. This should not be construed to mean that the entire personnel of the working force changes every year, for a very large number remain permanently; but it means that nearly 5000 men, which is more than there are in the whole organization, pass through the works every year, each having received a certain amount (and I know from the character of those works that each would receive a large amount) of personal attention, supervision and education, all of which are extremely costly. Now, if a company run under good business management should lose a large portion of its plant during a year by its being washed away by a stream which flowed by its side, it seems to me that a great effort would be made to prevent a recurrence of such a disaster. And there is all the more reason for summary action when the stream of humanity that flows by it carries away such a large part of the working organization. Recognized authorities on management have emphasized the importance of upholding the integrity and solidarity of the working organization. There is nothing so expensive to a company as constant changes in the personnel of its working force.* It seems to me that the weak point in our systems of industrial education is in not laying our foundation deep enough.

WORKS MUST HAVE ATTRACTIVE POWER

To my mind it is necessary, by the adoption of the simple means included in the term "industrial betterment," first to increase the *attractive force* in a plant in order to bring to it a better class of men, and second to develop a *cohesive force*, to hold them there. Then you can educate the organization to good and permanent effect. In order to develop these forces, you must teach the owners and managers of works the economic value of industrial ethics that they may appreciate the advantages to be derived from fair treatment and comfortable and sanitary surroundings, in order that men may be kept contented and in good physical condition for permanent service. In too many factories there are men and women overworked, underpaid, and otherwise unfairly treated. Too many factories are dark, cold, unventilated and otherwise unsanitary. All the education in the world that you can give your employees will not bring about in these places the results contemplated. Such conditions should be prevented as well as cured, and to bring about improvement in this direction intelligently, we should begin by having our schools and colleges educate our boys, who later may become factory owners and managers, in such a way that they will take into account the human element in business. "The conscience which recognizes obligation," which Mr. Alexander mentions (in paragraph 12) should be developed in the management as well as in the working organization.

A DEEPER FOUNDATION NECESSARY

The Society for the Promotion of Industrial Education, which our Mr. Higgins has just launched so successfully, held a meeting at Cooper Union last week, at which one of the speakers referred to a point which your president has brought up, viz., the severe competition of our country with Germany, and asked if it was not a fact that Germany, before she had established her industrial school system, possessed a deep realization of the value of the ethical treatment of her working people, and encouraged them to live a healthy, thrifty, and moral life so as to develop into strong, happy, and contented working men and women. Afterward she saw to it that they were given sanitary and cheerful working conditions, and then, but not till then, did she educate them.

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*In my paper No. 1101, Vol. 27, on "The Realization of Ideals in Industrial Engineering," presented at the last annual meeting, I quoted Andrew Carnegie as saying that should some great catastrophe destroy all of his mills, but spare his organization which had required many years to perfect, he might be inconvenienced temporarily, but that he could depend upon his organization to re-establish his business. If, however, he should lose his organization, even if his mills were the best in existence and were left intact, he would not have time nor strength to rehabilitate himself in the business world.

When we realize as deeply as Germany the true value of the full and willing service of a man, I think that then and not before shall we be able to pull the marker over to our side in the industrial tug of war between that country and our own.

Machinery in France—American Machine Tools Preferred—Indifference to Orders—German Methods

Special Agent Arthur B. Butman furnishes the following report on American machines and machine tools in France, which, owing to admitted superiority, are given preference in many cases. French purchasers complain of slow delivery, and in some instances of insecure packing. The report contains a number of points that will be interesting to manufacturers of machinery of all kinds.

In spite of the fact that in France there are upward of 6000 manufactories of iron and steel, so great are the requirements of her industries that large numbers of machines and machine tools are annually imported from foreign countries. The imports of machinery from the United States are constantly increasing, as will be seen from the following statistics. In 1903 the importation of American machinery was valued at $5,161,978; in 1904, at $6,127,171, and in 1905, at $6,721,418. American machine tools of all kinds find a ready market throughout the country.

I am informed that rarely is a machine shop to be found in France unequipped, partially at least, with American machine tools. The good reputation of American machines and tools gives them preference with the French buyer, who presents, however, the complaint of "slow delivery."

Paris I found to be the center of distribution for the country of machinery and machine tools made by Massachusetts, Connecticut, New York, Ohio, Illinois, and Wisconsin firms. One of our strongest competitors is the German, who imitates almost to perfection, cuts prices and makes quick deliveries. Machines of German manufacture, however, are held in less repute than our own.

GERMAN METHODS OF PUSH

The thorough preparation made by German manufacturers is illustrated in the following statement recently published in an English periodical:

"The rapid growth of German foreign trade is largely due to the fitness of the man sent out to get business. Before sending a salesman abroad he is thoroughly trained for the position. He must work in the drafting room to learn something about the design of the machines, but principally to lay out and make a correct scale drawing of any complete plant. Then he must work as assistant to the inspector, who runs and tests each machine before it is shipped. Here he learns how to operate the machines. He next goes out as a helper to the expert who sets up and starts the machines in the customer's works, and later is sent out alone to do so. Right here is one place where the German gets ahead of the American. When he sells machinery, he aims to have it erected and started by his own expert. What a world of trouble this avoids for both the buyer and the seller! We all know the countless complaints that vanish into thin air as soon as we send an expert from the factory to see why a customer's machine is not giving satisfaction. The reader must not get the impression that the salesman's education consists of looking on while the inspector tests machines, or while the expert is erecting a new outfit. On the contrary, this part of the business must be learned thoroughly. The salesman must work at it a year or two, especially at erecting machines.

"Here is the real education. Far from the shop, without assistance, he is thrown entirely on his own resources. About this time he is given a chance to show what he can do as a salesman in his own country. He now studies foreign languages, and, if he is successful as a salesman at home, he is sent abroad equipped with catalogs in the language of the country he visits. When such a man looks at his customer's work, he can tell exactly what machine is needed, and the best and cheapest way to do the work."

SLOW DELIVERY A HINDRANCE

As before stated, the great detriment to a larger increased trade in American machinery in France is the very slow delivery made by the manufacturer. In conversation with heads of importing houses this fact is constantly reiterated. American manufacturers do not give sufficient attention to their export trade. I find some importers of the opinion that Americans for the most part are too busy at home to care for foreign trade; but, if perchance business becomes a little quiet in the home market, then they grow anxious to extend their foreign custom. In the meantime our competitors, always anxious, have entered the market, which we could have held against other comers, and secured a foothold there. I was informed by one house of orders now placed in the United States for 260 machines of various kinds, some of these orders having been placed as long ago as August, 1905. It would seem that the foreign trade should have better attention if we wish to hold the markets we have gained.

PRICES AND PACKING

Foreign agents should always be notified at once of any advance in price. Neglect on the part of the manufacturer to do this causes great disadvantage to the agent, who, having contracted to deliver a machine at a certain price, finds, on sending the order to the United States, that it can not be filled at figures previously quoted, the price having advanced. The agent, however, must deliver the order as previously contracted, bearing the loss personally or lose the customer. This reported negligence on the part of our manufacturers does not tend to encourage the foreign agent in undertaking to handle new lines of American machinery.

The very important factor of packing should receive careful attention from the exporter. I am informed that many times machines are exported to foreign countries insufficiently protected against breakage, thereby frequently causing serious inconvenience and delay. I was shown by one importer a machine, weighing approximately 300 or 400 pounds, which had just arrived from the United States. The only protection for transportation in this instance was a crate of ¾-inch boards. The small adjustable parts, some ten in number, were simply wrapped in paper and tied on and about the machine. These small parts should always be packed in a box and securely fastened inside the crate. Fortunately, in this particular case, all arrived intact, but one can readily understand the amount of delay and inconvenience sometimes caused the importer by breakage or loss of attachments through bad packing methods. The duty on machinery varies, according to materials and degree of finish, from $2.31 to $13.50 per 100 kilograms (220 pounds).

AGRICULTURAL IMPLEMENTS AND BUILDER'S HARDWARE

The home manufactories of agricultural implements in France number about 15,000, but the agricultural interests of the Republic create a good home as well as foreign market. The total valuation of agricultural implements imported by France from the United States for the year 1905 was $2,817,998. I am informed by importing houses in Paris that the sales for American agricultural implements will show better returns for the present year than in 1905, the crops for 1906 being larger than usual.

Small farming tools of American manufacture are in good repute and find a fair sale. Germany is a strong competitor for this trade, quotes cheaper prices, and is prompt in delivery of goods.

The French-manufactured small tools are also lower in price. The American products give good satisfaction, and the only complaint is "slow delivery."

France imported from the United States in 1905 builder's hardware (all kinds) to the amount of $377,327. I am informed that the market for these articles might be largely increased in this country if proper attention were given by the manufacturer to the French orders. The products are well liked, but here again the same complaint regarding slow delivery is heard.

The monitor "Wyoming" is to be prepared for using fuel oil, and plans for placing the tanks have been made.

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Inaugural Banquet of the Exposition of Safety Devices

The inauguration of the movement for the arousing of public sentiment and the securing of legislation for the better protection of lives and limbs of working men, especially, but of the general public as well, was made in a striking manner by a banquet at the Waldorf-Astoria of this city, January 28. The banquet was held by the American Institute of Social Service, of which Dr. Josiah Strong is president and Dr. William H. Tolman is director; and while intended as an inauguration of the general movement it was intended more especially as an opening of the exhibition of safety devices and industrial hygiene, which is being held at the American Museum of Natural History, of this city, as we go to press.

This method of inaugurating an exposition is certainly novel as, in its inception, it was decidedly ambitious; but the outcome not only justified it, but served, as perhaps nothing else could have done, to place the seal of approval upon the entire movement. Certainly it is rare to find such an assemblage of distinguished men at a public banquet of any kind as were present on this occasion, and their presence can only be construed as an absolute indorsement by them of the proposed movement.

Governor Hughes was the guest of honor, and made what was in every way the most forcible speech of the evening. In this speech he pointed out, among many other things, the absurdity of the common-law ruling upon the comparative responsibility of master and servant, and upon the equality of the two as regards their freedom of contract, saying that workmen practically accept hazardous employment because compelled to do so in order to gain a livelihood, and that their supposed freedom of contract, in such cases, is an absurdity.

The extent of the indorsement of this movement, which this banquet implies, can best be understood by naming some of the distinguished men present, among whom, in addition to Governor Hughes, were the following:

L. D. Burlingame, representing the Brown & Sharpe Manufacturing Company; C. A. Coffin, president of the General Electric Company; G. E. Emmons, general manager of the General Electric Company; M. Ebray, consul general from France; Edward Holbrook, president of the Gorham Manufacturing Company; Hon. Seth Low, ex-mayor of New York; Count Massigilia, consul general from Italy; John H. Patterson, president of the National Cash Register Company; Baron des Planches, Italian ambassador to the United States; Charles Stewart Smith, ex-president of the New York Chamber of Commerce, and Hon. Carroll D. Wright, former U. S. commissioner of labor, and the direct representative of President Roosevelt, whose indorsement of the movement he bore.

Many of these gentlemen made speeches, among the striking ones being those of Doctor Strong, and of Mr. Wright, both of whom are, of course, familiar with the subject of accidents from a statistical standpoint. There is no doubt that accidents to working men, as well as to the general public, are far more numerous in this country than in the countries of western Europe, a fact which was referred to by Governor Hughes as a source of humiliation, and there is just as little doubt that many of these accidents are preventable. Doctor Strong described the situation by saying that in the face of these numerous casualties the public had become lethargic just as soldiers become lethargic toward the casualties of war, adding that if the casualties of any entire year could be concentrated into one day, the public would be astounded at the facts; and, comparing the losses of life with those of the war between Russia and Japa , he stated that in this country, so far as accidents or casualties are concerned, we are carrying on two such wars at the same time. Much has been said about the barbarities of war, but he thought the time had come when we should begin to realize the barbarities of peace.

In several of the countries of Europe, permanent museums of safety appliances are conducted, and the ultimate purpose of the Institute of Social Service is to establish such a museum here, the present exhibition being but preliminary to this museum. It is hoped that the present exhibition will arouse a popular interest in the subject which will carry the museum forward to success; and, certainly, if the success of the banquet is any indication of latent interest, these hopes will be justified.

The Electric Furnace in Iron and Steel Making

Some interesting statements regarding the possibilities of the Kjellin electric furnace in metallurgy were made in a recent lecture at Sheffield, England, by a member of the Kjellin Company. As applied to the production of pig iron the lecturer did not regard the electric furnace as practicable, saying that for such work power must cost next to nothing in order that the process should be carried out successfully. For crucible steel making, however, the reverse was true, the reason being, apparently, the superior heat efficiency of the blast furnace over the crucible furnace. Moreover, the furnace facilitates the making of large, crucible-quality ingots, as it is as easy to make a two-ton charge with it as a 60-pound charge.

Several of these furnaces are already at

work in Europe, one of 175 kilowatts capacity at Gysinge, Sweden, where it has been in successful use for the past five years. Two furnaces are in operation in Germany and three are under construction, two of them being of 750 kilowatts capacity; one of 450 kilowatts is at work in Switzerland, and one of 200 kilowatts in England.

The opinion expressed in the discussion was to the effect that, while high-grade steel could be made in the electric furnace, the process is not yet commercially successful. A committee of Sheffield experts was appointed to investigate the quality of electric-furnace steel and to compare it with that made by the standard processes.

New Publications

"Punches, Dies and Tools for Manufacturing in Presses." By J. V. Woodworth. 483 6x9-inch pages with 702 illustrations. The Norman W. Henley Publishing Company, New York. Price, $4.

The author's book on "Dies—their Construction and Use" is well known to our readers and was noted in these columns on its first appearance. On taking up this book our first impression was that it was a revised and enlarged edition of the previous book, but on the contrary, we find it entirely new. Some of it has already appeared in the columns of this and other papers, while other portions have been written for the book. Its scope is wider than its predecessor's, and it contains descriptions of nearly all kinds of dies used on punching presses. A chapter which will be found of special interest to many is devoted to the sub-press and its uses and advantages.

The Philadelphia Meeting of the American Foundrymen's Association

We are in receipt of a circular from the American Foundrymen's Association, announcing that by invitation of the Philadelphia Foundrymen's Association the next convention will be held in Philadelphia, May 21 to 24, 1907, the headquarters being at the Second Regiment Armory. It is expected to have an elaborate system of working exhibits that will surpass any previous efforts in this line. The exhibition will be open May 20 to 26.

It is announced that the Sheffield Scientific School of Yale University is offering courses especially for mechanics, and that instruction in these courses will be furnished at a nominal cost. The courses for the first year are: Mechanical drawing and machine design; steam and steam engines; practical electricity; and practical mechanics.

NEW TOOLS AND MACHINE SHOP APPLIANCES

A GEARED HORIZONTAL NUT-TAPPING MACHINE

A nut-tapping machine is shown in the accompanying illustrations, in which the spindles are horizontal, and which has a tap stop permitting the taps to remain in the holders after finishing their work on the nuts, until the operator is ready to remove them. On a machine of this type with four spindles, between 9000 and 10,000 ½-inch malleable iron nuts have been tapped in ten hours, and the same number of ⅝-inch nuts from six spindles in the same time. The nut-holder is in one piece and can be adjusted in a minute to suit taps of any length from 8 to 16 inches.

Simplicity, ease of operation, and facility of maintenance are aimed at in the design. The arrangement of flexible tubing and water trough is such as to enable a strong flow of water, oil, or compound to be kept running where it is most needed, and so as to wash away the chips into the chip pan.

The general appearance of the machine is shown in Fig. 1, and Fig. 2 shows the construction more clearly. The tap is held by a friction *A* in a collet *B*, secured in the spindle *C*, which is driven by worm and gear, as shown.

The operator takes hold of the handle *D*, draws back the slide *E*, and inserts the nut in the nut-holder. The slide *E* with the nut-holder *F* is made to follow the slide *E* from unnecessary travel after the threaded portion of the tap has gone through the nut. There is also an adjustable stop *H* back of the nut-holder *F* to prevent the tap from working out of the collet *B* while waiting for the operator

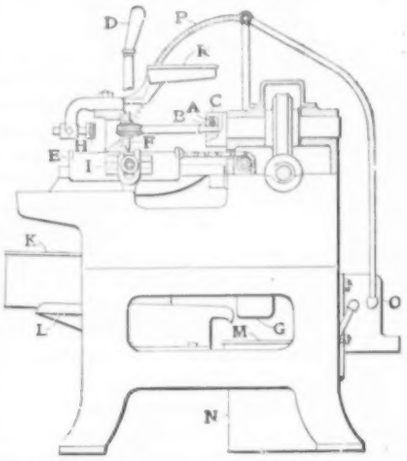


FIG. 2. ELEVATION, PARTLY IN SECTION, OF NUT TAPPER

to set it working again. When the shank of the tap has become full of nuts, the slide *E* is drawn back by the handle *D*, the tap drawn from the collet *B*, the nuts slide off the shank through an opening in

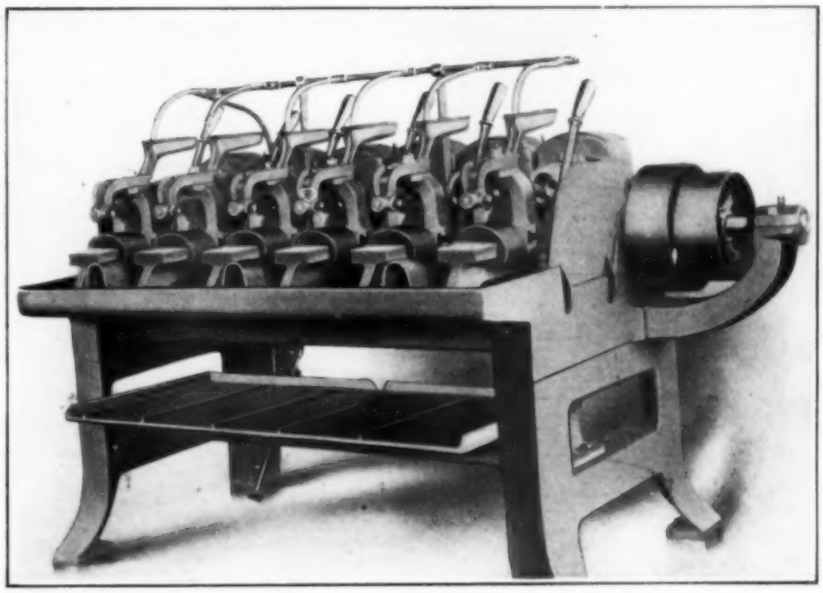


FIG. 1. A GEARED HORIZONTAL NUT-TAPPING MACHINE

nut during the operation of tapping, by the weight *G*, which is attached to the slide *E* by a chain passing over a roll in the head of the machine. An adjustable stop (not shown) is provided to prevent the bed into the tote boxes *K*, and the tap is replaced in the collet *B* without stopping the machine. Provision is made for using different lengths of taps by making the handle *D* and the slide *E* ad-

justable to each other by a bolt. The tote boxes *K*, with perforated bottom, allow the lubricant which adheres to the nuts to drain onto the table *L*, from which it runs into the settling pan *M*. The lubricant drains from the bed of the machine into the settling-pan *M*, which overflows into the tank *N*, from which it is drawn by the circulating pump *O*. The flexible tube *P* and elongated funnel *R* insure lubrication to the tap at any position of the slide *E*. Provision is made for removing the chips from the bed of the machine.

This machine is made by the Automatic Machine Company, Bridgeport, Conn.

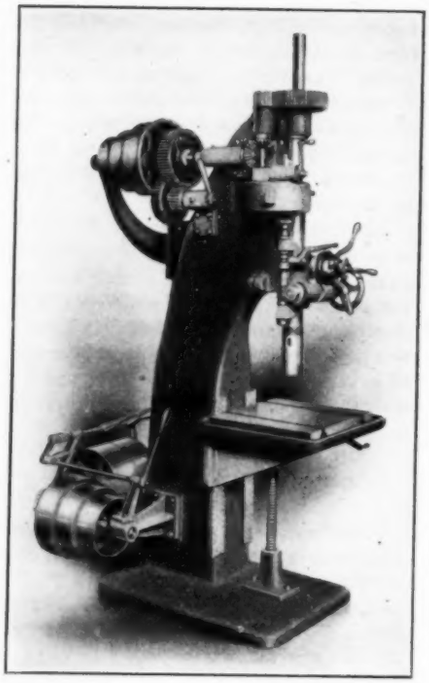
AN UPRIGHT POWER HAMMER

The illustrations show three views of a power hammer which possesses some features not usually found in power hammers. The hammer can be quickly and accurately set to accommodate various thicknesses of metal. This is effected by raising or lowering the fulcrum of the walking beam by turning the crank shown on the right side of the hammer. The crank actuates, through bevel gears, a screw upon which the fulcrum of the walking beam is hung. This adjustment permits metal as large as 8 inches diameter to be operated on without changing the stroke. The ram is hung on the links, as shown, and any movement of the ram either to or from the walking-beam end compresses the heavy coiled spring. The hammer is counterbalanced, and when it is at rest the operator can get his work in position on the anvil before starting the mechanism. The stroke of the hammer is adjustable from 4 to 8 inches; the ram weighs 90 pounds. The machine weighs 3100 pounds and occupies a space 46x46 inches and is 87 inches high. It is manufactured by the New Ulm Foundry and Machine Shop, New Ulm, Minn.

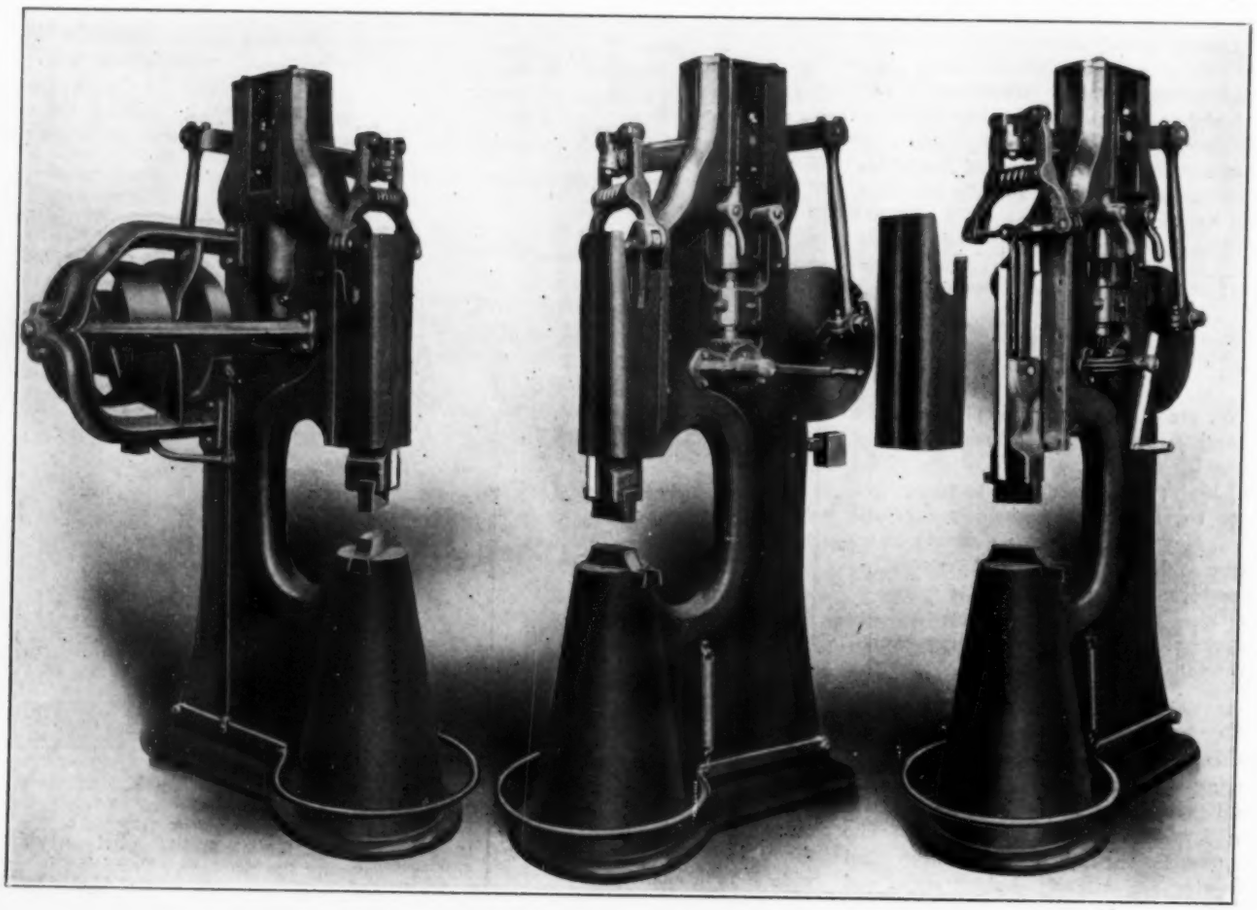
A HIGH-DUTY DRILL PRESS

The illustration shows a drill press designed to get the full efficiency of high-speed drills up to 2¼ inches diameter. The column and table will be observed to be extremely rigid to prevent deflection and eliminate one of the principal causes of breakage of drills.

The spindle is 2¼ inches diameter reamed at the nose for Morse taper No. 5. The quill is 23 inches long by 3⅝ inches diameter and is provided with ball thrusts having ⅝-inch balls. There are three changes of geared feed, from 0.007 to 0.033 inch per revolution, instantly available by shifting a lever located in front of the machine. The table is fitted to the column by a square locked slide and clamped by straps. It is supported and raised and lowered by a 2-inch square-thread screw in the center. Maximum distance from the nose of the spindle to the top of the table, 32 inches. Distance from the center of the spindle to the face of the column, 12 or 18 inches. Power feed to the spindle, 16 inches. Ratio of the back gear, 3½ to 1. Size of the table inside the oil pockets, 20x30 inches with two T-slots. Six gradations of speed



A HIGH-DUTY DRILL PRESS



AN UPRIGHT POWER HAMMER

are obtainable, from 25 to 168 per minute. This machine is built in two styles, plain and back-geared, and in two sizes, 24 and 36 inches swing, by the Foote-Burt Company, Cleveland, Ohio.

Foreign Markets for American Machinery

There is every prospect of a trade arising in Japan for flour-milling machinery. The new tariff, which went into operation last October, places a pretty stiff duty on imported flour. In view of this fact the native flour merchants and millers are considering the milling industry with much interest. A decided impulse seems to have been given to the milling industry, and circumstances now point strongly to importing wheat from abroad, and milling it at home. The Japanese home way of grinding is primitive, mostly by stone mortar and water wheel; but there are numerous mills which have adopted the foreign style, with an aggregate capacity of 6250 bushels per day of 24 hours.

SOME JAPANESE FLOUR MILLS

In view of possible business arising I append the names of some of the best of these mills, which are established concerns: Japan flour mill, Tokyo; Nagoya flour mill, Nagoya; Utsunomiya flour mill, Utsunomiya; Hiroshima flour mill, Hiroshima; Nagasaki flour mill, Nagasaki; Hokkaido flour mill, Sappuro; Yamagata flour mill, Yamagata; Sendai flour mill, Sendai; Tate Bayshi flour mill, Gunma; Kumagaya flour mill, Saikama; Tsuchiura flour mill, Saikama; and Matsudo flour mill, Chiba. The following new concerns are being started, and many more are under consideration: Japan flour mill, Kobe; Japan rice refinery flour department, Kobe; Masudaya flour mill, Kobe; Osaka flour mill, Osaka; two new mills in Tokyo; and flour branches of established companies.

FLOUR AND RICE CONSUMPTION

There is no reason why a substantial part of the business in milling plants should not be done by United States firms, and a communication to the companies interested, together with similar information to the importing houses, might be productive of business. I am, of course, aware that the amount of flour consumed in Japan, as contrasted with the rice consumption, is very small. But it is a growing trade, and the new duty will certainly tend to establish a milling industry within the country. I may add that it has been found better to feed the Japanese bluejackets on bread than on rice, as a preventative of the beri-beri sickness.

PROSPECTS IN CHINA

Your manufacturers might also keep an eye on the trade now arising in China. For instance, a gentleman in Tokyo is promoting the establishment of a flour mill in Hankow, which is a great wheat center in China. There is a good prospect for the milling industry there, and the promoter has been so far successful in the realization of his enterprise that an American manufacturer desiring to have an interest in the projected industry has contracted to become a partner of the Japanese enterprise, with a flour-mill machinery plant which the American firm he represents manufactures.

CHINESE DEMANDS FOR MACHINERY IN GENERAL

Indeed, China presents to-day a splendid opportunity for the development of trade in machinery of all kinds, the demand for cotton, flour, and paper-milling machinery being certain to increase rapidly. There is also a fair demand, which can be increased by up-to-date business methods, for lathes, wood-working machinery, steam pumps, hand and power-drilling machines, metal planers, engines and boilers, electrical machinery, dynamos and motors, valves and fittings. I may add, too, that the Chinese are fully alive to the importance of establishing cotton-weaving mills, and mills of this kind will, in a comparatively short time, be erected in various parts of the empire.

OPPORTUNITIES IN BRAZIL

Turning to Brazil I may note that the recent low market prices of coffee have emphasized the necessity of reducing the cost of production, and labor-saving machinery would command a ready sale. Machines for the treatment of the coffee, after it is harvested have already reached a high degree of perfection; but the cultivation and picking are still largely done by hand. The State of San Paulo is about to offer prizes for the invention of such machines. These will take the form of a cash premium of considerable amount, a trophy to be held until some superior invention claims it, and the granting of exclusive selling rights for several years.

A COFFEE PICKER WANTED

The device most needed is for picking coffee, as this would be the key to the whole situation. Machinery could long ago have been introduced into the cultivation and winnowing of the coffee were it not for the present necessity of keeping a large number of employees at work the entire year so as to have abundant labor at hand during the few months of the picking season. A satisfactory picker would make the future of its inventor. Cultivators and winnowers would be the next step, if the prizes offered will cover these machines as well.

THRESHING MACHINES FOR ARGENTINA

It is rather a matter of surprise that American makers of threshing machines do not seek to control the market for these goods in the Argentine Republic. There is a big market there for such machines. Apparently they do not come up to the high standard of excellence of the British makes, but are offered at lower prices, and are not so well finished. They are usually fitted with traction engines to facilitate their transportation. The engines, although usually sold as being of from 30 to 35 horse-power, in practice are only of 12 to 14 horse-power. About 800 threshers are in use in the province of Cordoba alone.

PORTABLE ENGINES, CORN SHELLERS, ETC.

French portable engines are not much liked in consequence of having one serious fault. These engines are meant to use straw as fuel, and in the French makes the furnace is too small to permit the full indicated horse-power being obtained. There are about 800 corn shellers employed in the province, worked by steam, and in addition innumerable manual machines of the same type, all of American manufacture.

NORWAY WANTS ENGINES FOR SMALL BOATS

There is a demand at Christiansand, Norway, for engines for fishing boats, pilot steamers, and small cargo boats. Up to the present these have been supplied by an American house. As very few engines are made in Norway itself, the trade is one which offers a good prospect for exporters to Norway.

AN OPENING IN SPAIN FOR CRANES

Makers of electrical cranes should note an opening which exists in Spain. The commissioners of works of the port of Huelva have just built a new mole, upon which it is proposed to erect four cranes worked by electricity. As the only means of obtaining power at present is the combined gas and electric installation in Huelva, which belongs to an English company, and of which the power produced is rather limited, it has been suggested to open new works for this purpose. Huelva is a town of about 30,000 inhabitants, and owing to the lack of electrical power there are no tramways or similar enterprises. The establishment of an installation as proposed would have excellent results. There is here a first-rate opening for business on the lines suggested. F. C. C.

London, England.

"Theory" and "Practice" in the Making of a Mechanical Engineer

Wilson E. Symons, president of the Pioneer Cast Steel Truck Company, Chicago, addressed the Engineering Assembly of Purdue University, Lafayette, Ind., on January 21. Mr. Symons chose for his subject: "Theory versus Practice in the Work of the Mechanical Engineer." Drawing upon an extensive personal experience, he presented his subject in a manner which was most interesting and instructive to his student audience. He described the helplessness of a man trained in theoretical matters only, discussed with care and discrimination the limitations which surround one whose entire stock in trade is his practical experi-

ence, and drew a fine picture of the opportunities which await the one who combines the theoretical with the practical. Such a combination he regarded as essential to the development of the ideal engineer.

Personal

John E. Zimmerman, formerly secretary of the American Pulley Company, of Philadelphia, has become a partner in the firm of Dodge & Day, Philadelphia.

The M. H. Treadwell Company's Dinner

The third annual dinner of the M. H. Treadwell Company, 95 Liberty street, New York City, was given at Rector's, January 12, 1907, at 7:30 o'clock. Covers were laid for thirty-two. This is a courtesy annually extended by the company to its office employees, superintendents and foremen, to assist in promoting sociability and good fellowship. Toasts were responded to by J. H. Killinger, president; H. N. Dougherty, vice-president; M. H. Treadwell, treasurer; A. F. Colling, purchasing agent; A. H. Stein, assistant secretary; W. E. Farrell, manager of Lebanon plant, and R. McCarty, manager of Myerstown plant. Music was furnished by Charles Von Barr.

Business Items

The name of W. F. Burditt, Jr., N. Y. has been changed to W. F. Burditt Machinery Company. The business will be confined to the bar, plate and sheet metal working machinery industry.

The Ridgway Dynamo and Engine Company has just completed a large addition to its works at Ridgway, Penn., and is now putting it into service. This will furnish a much needed relief to their overcrowded machine shop.

Peter A. Frasse & Co., 92 Fulton street, New York, have sold their vise manufacturing plant to G. M. Yost Company, Mechanicsburg, Penn., who will continue to manufacture the Stephens and Snediker Rapid Transit vises, Snediker leg vise and a line of bulldog vises.

W. S. Barstow & Co., of New York, and Portland, Ore., have added to their organization a commercial department, which has been placed in charge of G. H. Noble. Mr. Noble was for six years a salesman in the New York office of the Stanley-G. I. Electric Manufacturing Company.

It is reported that the Rockford Machine Tool Company, of Rockford, Illinois, manufacturers of the "Rockford" shaper are preparing to bring out a line of planers, which will necessitate extensive additions to their plant. It is expected that building operations will be begun in the spring.

The Link-Belt Company, of Philadelphia, Chicago and Indianapolis, has opened branch offices at 321 Elliott Square Building, Buffalo, N. Y., H. C. Miner, manager, and 440 New York Block, Seattle, Wash., E. G. Brabrook manager. Increased business in their conveying machinery, "Renold" silent and other forms of power transmission chains has made this necessary.

Miscellaneous Wants

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cox Computers, 75 Broad St., New York.

See illustrated ad page 191—H. A. Lowe.

Caliper cat.free. E.G.Smith Co., Columbia, Pa.

Universal Test Indicator circulars free. H. A. Lowe, Lock Box 146, Cleveland, O.

Working drawings. Experimental work. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago.

Light, fine machry. to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Dies and Diemaking. $1.00. A shop book by a shop man. J. L. Lucas, Bridgeport, Ct.

Gas engines designed to order. Marine and automobile work a specialty. H. L. Towle, 150 Nassau street, New York.

We want to hear from parties who desire to make some gasolene engines. Address "M. R.," care AMERICAN MACHINIST.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—Upright drills for sale in Great Britain, France and Italy. Will carry large stock. Apply Box 456, AMERICAN MACHINIST.

Special machinery to order. Catalog of small engines and boilers and engine castings 10c. Sipp Elec. & Mach. Co., Paterson, N. J.

Piano player, bandsaw, or electric motors to exchange for milling machine, shaper drill press, lathe or small tool. Box 563, care AMERICAN MACHINIST.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Do you known that special tools for manufacturing light interchangeable machine parts are just what the Prov. Mfg. & Tool Co., Providence, R. I., U. S. A., can make for you?

Among the 573 positions described in current issue of opportunities should be several of especial interest to you. Sample copy free. Write us today. Hapgood's, 305 Broadway, N. Y.

Have you a machine, the parts of which you wish made of sheet metal? If so, try the Prov. Mfg. & Tool Co., Providence, R. I., U. S. A., designers and manufacturers of light interchangeable mechanism.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACH.

Not using the whole of our modern factory plant, we should like to take up the building of any small high-grade machines, or parts of machines, in large or small quantities. United Sewing Machinery Company, Springfield, Mass.

Business Opportunities

General machine shop superintendent or foreman wanted by good company. Must invest $4000 or $5000. Make engines and do general repair work. Box 608, AM. MACH.

Planers—A recently designed reversing gear for planers which does not involve the reversal of any gear except the rack pinion and the shaft on which it is mounted. Simple and efficient. Patent to be disposed of. Apply for particulars to W. P. Davies, Danielsville, Pa.

An eighth interest in a new, successful speed-changing device of exceptional possibilities, patented in nine countries, now manufactured in England and just being placed on American market; $2000, payable easy instalments, or $1850 cash. Inventor and others spent $8000 in perfecting invention, and above is required to enable them to fill first orders. Box 586, AMERICAN MACHINIST.

We can build machinery for quick delivery. A shop building machine tools wishes to take contracts for the construction of machinery or anything that can be produced in a foundry and machine shop. Send drawings and specifications and estimates will be made with guarantee of quick delivery. We can refer to a standard line of tools now on the market as to the quality of workmanship. Box 75, AMERICAN MACHINIST.

For Sale

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—The leading jobbing pattern shop of Colorado. Address J. L. Gard, Denver.

For Sale—Astall Iron Works, machine-shop plants, established 40 years. Jesse Astall, Galveston, Texas.

For Sale—Two second-hand cupolas in first-class condition; shells 72"—82" in diameter and about 40 feet high. Box 333, AM. MACH.

For Sale—Cyclopedia of modern shop practice, four volumes; bound in green morocco leather. Practically new; cost $18; will sell for $6. Address L. N. O., Box 425, Chicago, Ill.

Wants

Situations and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted Position as chief engineer; have first-class Mass. license; have been instructor in steam engineering; familiar with hydraulic and cross compound condensing and electric plants. Box 509, AMERICAN MACHINIST.

ILLINOIS

Draftsman — Engineer in charge of large drafting room in the West wants work in the East. Box 546, AMERICAN MACHINIST.

IOWA

Mechanical engineer wants to get charge of a line of work with good people; $1600. Box 387, AMERICAN MACHINIST.

MASSACHUSETTS

First-class machinist, an originator; very successful developing new ideas; open for engagement March 1; six and one-half years at present place. Address Box 420, Walpole, Mass.

General foreman or assistant superintendent for shop producing valves, fittings, and piping for high-pressure power plants; 12 years' shop experience as toolmaker foreman and designer; excellent references. Box 580, AMERICAN MACHINIST.

MICHIGAN

Designer, college graduate, wants to change; four years' drafting, one year shop experience; hoisting machinery preferred. Box 584, AMERICAN MACHINIST.

General foreman or master mechanic, thoroughly practical and natural executive; am at present holding position as foreman of toolroom of a large automobile factory; 7 years' experience as foreman and assistant superintendent of factory manufacturing hardware supplies; will go anywhere; age 32; can furnish best of references. Address Box 582, AMERICAN MACHINIST.

NEW JERSEY

Designing draftsman wishes to make a change; experience in automatic tool machinery, fixtures and jigs for duplicating work. Address "H. R.," AMER. MACHINIST.

Position as superintendent, purchasing agent, or manager, thoroughly practical engineer, now holding responsible position. First-class references as to character, business and mechanical ability. Box 510, AM. MACH.

NEW YORK

General foreman of shop; master mechanic, producing varied high-grade work at lowest cost. Box 599, AMERICAN MACHINIST.

Designer and checker, ten years' experience, technical, shop and office training, wishes to change. Box 611, AMERICAN MACHINIST.

Position as foreman and designer by a toolmaker; jigs, gages, diemaking, etc.; $24 per week; 25 years' experience. Box 585, AMERICAN MACHINIST.

Mechanical engineer, experienced designer on automobile, marine and stationary gasolene and oil engines, is open to engagement. Box 508, AMERICAN MACHINIST.

Machine designer—technical education, 8 years' shop and drafting-room experience—

desires position; specialty, internal combustion engines. Box 600, AMER. MACHINIST.

Expert in patent drafting and developing desires a few more clients; intricate machinery specialty; A-1 work for A-1 price; secrecy guaranteed. Box 606, AMER. MACH.

Experienced mechanical draftsman, technical graduate; 7 years chief draftsman with manufacturing concern; desires position south or southwest. Address Box 538, AM. MACH.

Foundry foreman of 20 years' experience as foreman of large shops doing loam, dry-sand and heavy green-sand work, desires position; can furnish best references. Box 593, AMERICAN MACHINIST.

Position as manager of works; held similar position seven years; can improve and design machinery; good mechanical, executive and business abilities; furnish best of references from concern where now employed. Box 374, AMERICAN MACHINIST.

Mechanical expert—possessing a thorough practical knowledge of electricity, up-to-date in the application of modern machinery and tools and manufacturing in general, very successful in designing and introducing labor-saving tools and fixtures—desires a position as master mechanic, factory superintendent or other responsible position. Box 592, AMERICAN MACHINIST.

Assistant superintendent or master mechanic; American; 34; 9 years a machinist; 10 years' office experience on high-grade duplicate machines, equipment and maintenance; expert designer of machinery, jigs and fixtures with competent, energetic, practical and technical executive ability; at present employed; A-1 references; salary should approximate $2600. Box "R. A. G.," AM. M.

NORTH CAROLINA

Mechanical engineer, 10 years' experience on steam and gas engine, in shop and drafting room, desires change as designer or assistant superintendent. Box 581, AM. MACH.

OHIO

Mechanical engineer wishes to change; experience in steam turbines, gas engines and general machinery. Box 598, AMER. MACH.

PENNSYLVANIA

Position as superintendent or general foreman; specialty automobiles. Box 610, AM. M.

Superintendent or shop manager, twelve years' shop drafting, engineering and business experience; let me give you my qualifications; West or South preferred. Box 604, AMERICAN MACHINIST.

Mechanical engineer, expert designer on gas and gasolene engines, special machinery, tools and fixtures for interchangeable parts, wishes change; practical and inventive man thoroughly familiar with modern office and shop methods. Box 596, AMER. MACH.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—Four telephone engineers, one fire alarm apparatus engineer, six switchboard draftsmen, six apparatus draftsmen, two tool designers. Box 597, AMERICAN MACHINIST.

Wanted—A first-class machine shop foreman for large factory in Canada. Apply, giving references, experience and wages required to Box 603, AMERICAN MACHINIST.

CONNECTICUT

Machinists wanted—Lathe, drill press and bench hands, to work on tools and automatic machines; give full particulars. The Boesch Mfg. Co., Danbury, Conn.

Wanted—First-class operator on Jones & Lamson turret lathe; also one first-class all-around machinist. The New Machine Co., Danbury, Conn.

ILLINOIS

Wanted—At once; good man on Barrett's horizontal boring machine; open shop; must be A-1; give references, stating wages. The American Well Works, Aurora, Ill.

Wanted—Draftsman and designer for presses and sheet metal working machinery. One with executive ability preferred. State full particulars. Box 612, AMER. MACHINIST.

Wanted—Draftsman to have immediate charge of drafting room, by an established firm making high-grade automatic machines and having extensive enlargements under construction; must be familiar with jigs and fixtures for the production of interchangeable parts, and also must have first-class ability in designing them; in replying please give age, nationality, whether married or single, and salary expected; applicants will facilitate matters by giving a brief but clear account of training and experience, together with references. Box 602, AMERICAN MACHINIST.

INDIANA

Wanted—Lathe men, tool makers, and machinists. Good wages; steady employment; increasing force. The Western Motor Co., Logansport, Ind.

Wanted—High-class designing engineer for rotary engines; salary $5000 to $10,000 per year to man who has had definitely successful experience. Reply care Box 545, AM. M.

Wanted—Young man skilled in high-class mechanism and tool making, for position as superintendent in sewing machine factory; good salary and good opportunity to right man; address giving full particulars. Box 583, AMERICAN MACHINIST.

KENTUCKY

Wanted—Capable boilermaker to do laying out and superintending boiler shop; references required. Address Indian Refining Company, Georgetown, Ky.

MASSACHUSETTS

Wanted—A first-class designer on automobile jigs and fixtures. Must report at once and be a high-grade man. Address Superintendent, Waltham Mfg. Co., Waltham, Mass.

Wanted—Foreman draftsman; one with cotton mill experience as master mechanic, and acquainted with jig work and machine shop methods preferred; state experience, qualifications and wages required. P. O. Box 2815, Boston, Mass.

MEXICO

Wanted—First-class iron molder foreman on heavy and light work; must be a hustler, be able to give results and willing to go to Mexico; finest of climate; salary $150; gold per month to commence. Address: Compania Industrial Mexicana, Box 49, Chihuahua, Mex.

MICHIGAN

Wanted—Machinists A-1. Experienced on large, high-class engine work. Olds Gas Power Company, Lansing, Mich.

Foreman who has had experience building small steam engines to act as sub-foreman of erecting floor. Box 590, AMER. MACHINIST.

Draftsman with technical education, who has had experience in designing special machine tools for heavy work; state experience and wages expected. Engineering Department, Great Lakes Engineering Works, Detroit, Mich.

MISSOURI

Wanted—First-class adjusters accustomed to adding machine and typewriter work. Universal Adding Machine Co., St. Louis.

NEW ENGLAND

Leading house with established trade wants experienced mechanic, conversant with turret lathes, automatic machines, etc., to cover parts of New England, calling on metal working plants; state age, experience, salary expected at start. Box 576, AMER. MACH.

NEW HAMPSHIRE

Wanted—A draftsman experienced on machine tools; state experience and wages expected. Address Flather & Co., Inc., Nashua, New Hampshire.

NEW JERSEY

Wanted—Three first-class lathe hands, in New Jersey 12 miles from New York City, steady work to good men. Reply Box 609, AMERICAN MACHINIST.

Screw-machine operators wanted on automatics—Acme, Pratt & Whitney or Spencer; able to set up jobs; steady work; highest wages. Mack Mfg. Co., 401 St. Paul's avenue, Jersey City, N. J.

Wanted—Tool, die and instrument makers accustomed to accurate, complicated work; steady work and good wages to thoroughly competent men; give references. Address Box 438, AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

As we are continually adding to our departments, we have openings for men familiar with engines and pumping machinery; we require lathe, planer, shaper, drill and vise hands, also erectors for inside and outside work; good pay and steady work to good men. Address communications to Henry R. Worthington, Harrison, N. J.

NEW YORK

First-class tool and diemaker, experienced in manufacture of sheet-metal chains, to take charge of small shop. Box 595, AM. MACH.

Wanted—Automatic screw machine operators; experienced on Brown & Sharpe machines. Remington Typewriter Factory, Ilion, N. Y.

Wanted—Experienced draftsmen, toolmakers and machinists; give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Wanted—Detail draftsmen and tracers on work similar to construction work; state age, salary and experience. Address Box 574, AMERICAN MACHINIST.

Wanted—Toolmaker for screw dep't. with experience on automatic screw machinery and general tool work. Remington Typewriter Factory, Ilion, N. Y.

Draftsman on steam pumps in New York City; state experience, references, and pay expected. Address Cameron, 433 E. 23d street, New York City.

First-class tool and die maker experienced in the manufacture of sheet metal chains to take charge of a small shop. Atlantic Co., 109 South 5th St., Brooklyn, N. Y.

Three careful draftsmen wanted to act as checkers on dimensions; previous experience in our line not absolutely essential; salary $21 to $24. Address Box 573, AMER. MACH.

A number of first-class lathe, planer, slotter and boring-mill hands for both day and night shift; good pay and steady work to good men. The Snow Steam Pump Works, Buffalo, N. Y.

Wanted—Machinist, first-class mechanic, to assemble gas engines with unskilled help; state experience and wages; good opportunity for quick, reliable and accurate man. Box 588, AMERICAN MACHINIST.

Wanted—First-class diemakers on small and medium blanking, forming, and drawing dies for tin boxes; and general sheet metal work. Steady employment to first-class men. Burdick & Son, Albany, N. Y.

Wanted—First class, experienced, designing, mechanical and electrical draftsman to take charge of drafting department; steady position to capable man; state age, experience and salary expected. Box 589, AM. MACH.

Wanted—Experienced loam molder, competent to take charge of a foundry in New York State; must be a good manager and estimater. Address, stating age, experience, reference and wages wanted. Box 594, AM. M.

Wanted—For iron machine shop, man thoroughly experienced in turning out small and interchangeable work economically; capable of taking charge of 100 men; man on valves preferred. Address Box 578, AMER. MACH.

Wanted—Brass foundry foreman, experienced on valves and fittings and molding machines preferred, in reply state age, experience, whether married or single, and where employed at present. Address Box 572, AMERICAN MACHINIST.

Wanted—An experienced mechanic who understands flat turrets, automatic machines, bolt cutters, to represent a well known house in calling on iron and steel workers in New York State outside of New York City. State age, experience, salary at start. Box 560, AMERICAN MACHINIST.

Experienced iron foundry superintendent, or foreman wishes situation; first-class references, heavy, and light machinery castings, loam, dry green-sand, molding machines; well up in cupola practice, mixing by analysis, producing first-class castings economically; now employed. Address Box 605, AM. MACH.

Tool and diemaker—Must be first class, capable designing and making, blanking, perforating, drawing and forming dies; also small accurate jigs and general screw-machine tools; must be capable of making brass patterns and able to read and make working drawings; man who has worked in shop of from 50 to 75 men preferred. Address Box 591, AMERICAN MACHINIST.

Wanted—Foreman machinist; energetic, capable man under 40, competent to take charge of a shop engaged in building special machines and employing about 30 men; must be strictly temperate, able to estimate correctly on work, and have considerable mechanical and business ability. Address, A. H. Farnham, Box 607, AMERICAN MACHINIST.

OHIO

Wanted—First-class designing draftsman familiar with automatic machinery and power punches; steady position to capable man. Box 388, AMERICAN MACHINIST.

Wanted—First-class structural engineer capable of designing steel buildings, bridges, etc.; state age, qualifications, initial salary expected, etc. Address 567, AMER. MACH.

Machinists—Lathe and floor hands for strictly first-class machine tool work; steady employment; new enlarged works just completed. The Warner & Swasey Co., Cleveland, Ohio.

Foreman for general lathe department, including engine lathes, Gisholt lathes and grinders; present force in department, about 50; must be thoroughly competent as foreman and accustomed to accurate work; state in what capacity and where employed for past five years or more; also give age. Box 565, AMERICAN MACHINIST.

Production dept. head; a practical experienced man, thoroughly capable of introducing piece-work, setting rates, and directing

output, in modern shop employing several hundred men; line of manufacture, high-grade machine tools; state age and education, and give full particulars regarding experience. Box 566, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—First-class floor hands and fitters for machine-tool work. Colburn Machine Tool Company, Franklin, Pa.

Wanted—First-class draftsman on machinery for iron pipe fittings; state age and experience. Address, The Kelly & Jones Company, Greensburg, Penn.

Draftsmen wanted — Experienced draftsmen in electrical apparatus, switchboards, transformers, motors and generators; only first-class men need apply; state experience and salary expected. Address Chief Draftsman, Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

RHODE ISLAND

Toolmakers wanted—First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Peirce Mfg. Co., Woonsocket, R. I.

TENNESSEE

Wanted—Two mechanical draftsmen; previous experience in blast furnace and general steel or smelting plants necessary; applicants must state education and experience in detail, with reference, and salary expected. Address Box 601, AMERICAN MACHINIST.

WISCONSIN

To cope with the continuous enlargement of our business, first-class machinists, patternmakers, molders and boilermakers can find steady employment. Box 899, Milwaukee.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reasons for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

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Dyson & Sons, Jos., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Bone for Case Hardening

Rogers & Hubbard Co., Middletown, Conn.

Books, Mechanical

American School of Correspondence, Chicago, Ill.
Derry-Collard Co., New York.
Henley Pub. Co., N. W., New York.
Hill Publishing Co., New York.
Piers, Frank, Phila., Pa.
Sames, C. M., Jersey City, N. J.
Wiley & Sons, Jno., New York.

Boosters

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, Ohio.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Stow Mfg. Co., Binghamton, N. Y.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Fairbanks Co., Springfield, Ohio.

Boxes

Cleveland Wire Spring Co., Cleveland, O.

Brackets, Lamp

Standard Welding Co., Cleveland, Ohio.

Brakes, Magnetic Friction

Electric Controller & Supply Co., Cleveland, O.

Broaching Machines

Burr & Sons, John T., Brooklyn, N. Y.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Lapointe Mach. Tool Co., Hudson, Mass.

Bulldozers

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
National Machinery Co., Tiffin, O.
Prentiss Tool & Supply Co., New York.
Toledo Machine & Tool Co., Toledo, O.

Cabinets, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.

Calipers

Athol Mach. Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.

Calipers—*Continued.*

Slocomb Co., J. T., Providence, R. I.
Smith Co., Ernst G., Columbia, Pa.
Starrett Co., L. S., Athol, Mass.

Cams

Bilgram, Hugo, Phila., Pa.
Boston Gear Works, Norfolk Downs, Mass.

Carborundum

See Grinding Wheels

Carriers

Lamson Consolidated S. S. Co., Boston, Mass.

Case-Hardening

Rogers & Hubbard Co., Middletown, Conn.

Castings, Brass and Bronze

Lumen Bearing Co., Buffalo, N. Y.
Nolte Brass Co., Springfield, Ohio.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Castings, Iron

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fairbanks Co., Springfield, O.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Hopson & Chapin Mfg. Co., New London, Conn.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.

Castings, Motor

Brush & Hudson, Brooklyn, N. Y.
Harrison, H. K., St. Paul, Minn.
Steffey Mfg. Co., Phila., Pa.

Castings, Steel

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel

Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
National Machine Co. The, Hartford, Conn.
Phœnix Mfg. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving

Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Cullman Wheel Co., Chicago, Ill.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold

Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines

American Tool Wks. Co., Cin., O.
Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, Ohio.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.

Chucking Machines—*Cont.*

Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Oneida Natl. Chuck Co., Oneida, N. Y.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Wells Bros. Co., Greenfield, Mass.
Westcott Chuck Co., Oneida, N. Y.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe

Cushman Chuck Co., Hartford, Conn.
Davis Machine Co., W. P., Rochester, N. Y.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Oneida Natl. Chuck Co., Oneida, N. Y.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Ct.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer

National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Oneida Natl. Chuck Co., Oneida, N. Y.
Reed Co., Francis, Worcester, Mass.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.

Chucks, Split

Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.
Westcott Chuck Co., Oneida, N. Y.

Circuit Breakers

Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps

Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Le Count, Wm. G., So. Norwalk, Conn.
Tudor Mfg. Co., Worcester, Mass.

Clutches, Friction

Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons Co., T. B., Chambersburg, Pa.

Clutches, Magnetic

Electric Controller & Supply Co., Cleveland, Ohio.

Coal Handling Machinery

Link-Belt Co., Philadelphia, Pa.

Coils

Standard Welding Co., Cleveland, Ohio.

Collectors, Pneumatic

Sturtevant Co., B. F., Boston, Mass.

Compound, Pipe Joint

Dixon Crucible Co., Joseph, Jersey City, N. J.

Compressors, Air

Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Smith Fdry. Supply Co., J. D., Cleveland, O.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas

Ingersoll-Rand Co., New York.

Conduit, Interior

Sprague Electric Co., New York.

Cones, Friction

Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps

Leard, Wm. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work

Blanchard Mach. Co., Boston, Mass.
Chapman & Co., J. B., Springfield, Mass.
Skinner Ship Bldg. & Dry Dock Co., Baltimore, Md.
Turner Mach. Co., Danbury, Conn.

Controllers and Starters, Electric Motor

Case Mfg. Co., Columbus, O.
Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveying Machinery, Auto

Lamson Consol. S. S. Co., Boston, Mass.

Coping Machines

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Cork Inserts

National Brake & Clutch Co., Boston, Mass.

Corundum

See Grinding Wheels.

Cost Systems

American Mechanical Calculator Co., Cincinnati, O.

Cotters

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.

Countershafts

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Mossberg Wrench Co., Central Falls, R. I.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction

Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

THE U. S. NAVAL GUN FACTORY AT WASHINGTON, D. C.—IV

The Process of Constructing a Gun—Boring—Turning—The Shrinkage Pit—The Rifling Machine—Rigorous Inspections and Measurements at Every Stage

BY H. J. KENNEDY

The material used for building up the guns is, as is well known to readers of the AMERICAN MACHINIST, open-hearth nickel steel, fluid-compressed, forged, oil-tempered and annealed. The use of nickel steel has given a much higher elastic limit and tensile strength as compared with carbon steel, without a reduction of ductility. The material comes from the steel companies, the Bethlehem, Midvale or Carnegie companies, and is furnished to the navy yard rough-bored and turned, the tubes being turned to within one inch of the finished dimensions, and the other parts to within ¼ inch. Upon receipt of the forgings at the gun factory they are weighed and carefully examined, and no work is done on them until the marks of the steel works and the inspecting officers are found; an examination for every discoverable defect is made at the navy yard, and the forgings are also measured to find whether they will work out satisfactorily to the finished dimensions. It is the aim to put in any one gun forgings all coming from the same steel works.

The nickel steel used for making guns has the following approximate average physical qualities: tensile strength, 100,000 pounds per square inch; elastic limit, 70,000 pounds per square inch; elongation at point of fracture, 19 per cent., contraction of area, 33 per cent. The steel contains about 3 per cent. nickel and 0.3 per cent. carbon.

The machine which does the most of the finishing of the principal parts of a gun is, of course, the king of machine tools, the lathe; and we have seen that the gun shop contains some big specimens of this tool. The amount of the shop's product is largely assisted by the fact that the forgings are received rough-turned. The sequence of the operations is, in brief, the boring of the jacket, the turning of the tube, the shrinking of the jacket upon it, and the subsequent turning of the exterior, followed by the shrinking on of the hoops one by one, each being turned after it is

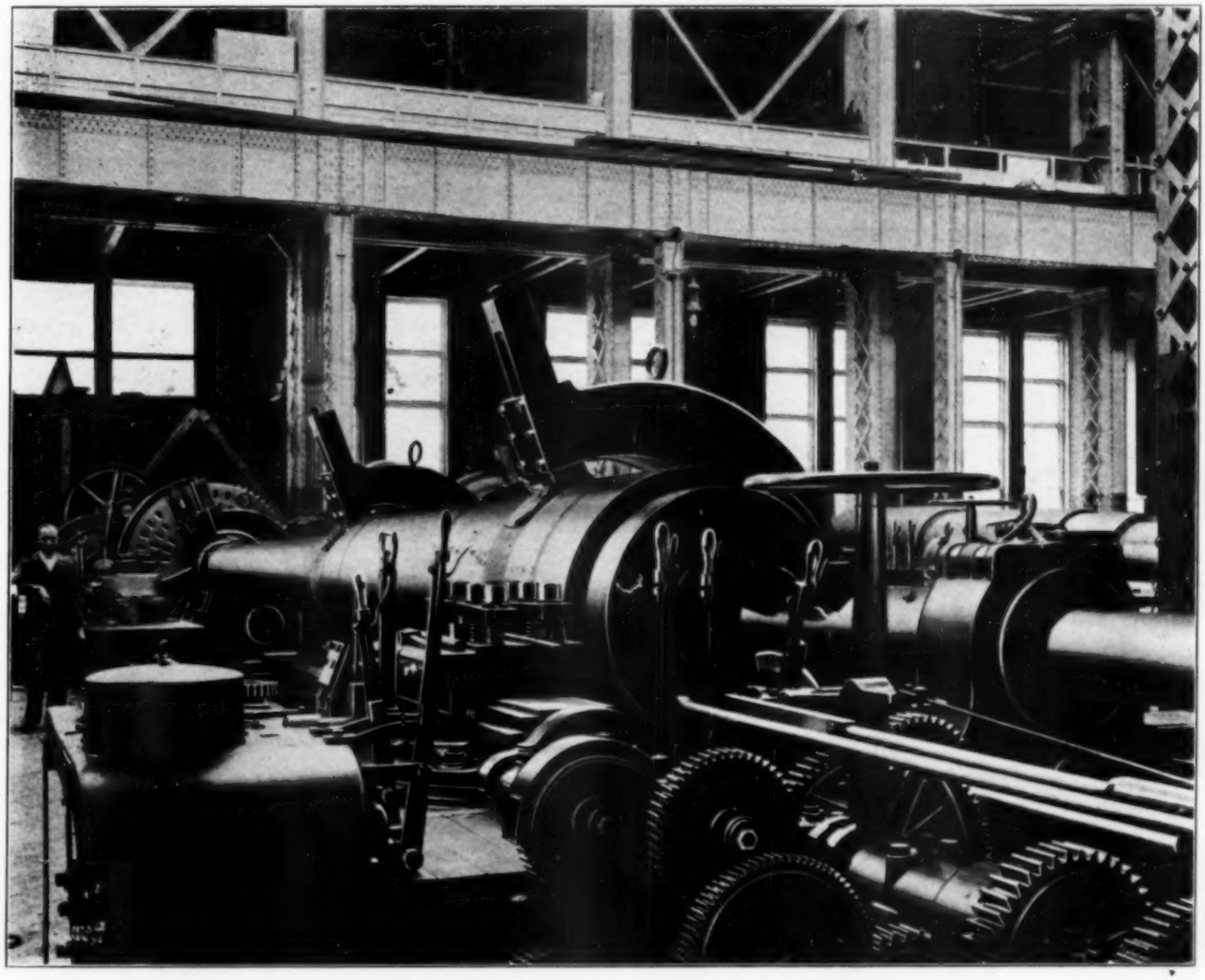


FIG. 21. 12-INCH GUN IN LATHE IN NORTH GUN SHOP; BORING BAR AND TOOL AT THE RIGHT

shrunk on. The gun is then bored, the powder chamber is finished and the thread for the screw box is cut, the gun is rifled and the breech mechanism is attached.

BORING

The boring, except for short hoops of large diameter, is done by boring bits. In order to start these it is necessary first to cut out from three to six inches of the bore with an ordinary lathe tool.

THE HOG-BIT

For the roughing cuts a hog-bit is used, which is a semi-cylinder of cast iron, hollowed out in the middle and carrying at a front corner one tool fastened to it by screws, as shown in the sketch, Fig. 22.

A hog-bit on the boring bar can be seen in Fig. 21, which is a view of one of the Bement-Miles lathes, preparing to chamber a 12-inch 45-caliber gun. The hoop for the breech of this gun has an inside diameter of 48½ inches and a length of seven feet. This cut is one inch deep, 0.03 inch feed, cutting speed seven feet per minute.

THE PACKED BIT

The finishing cuts are taken with a packed bit, shown in sketch Fig. 23, which

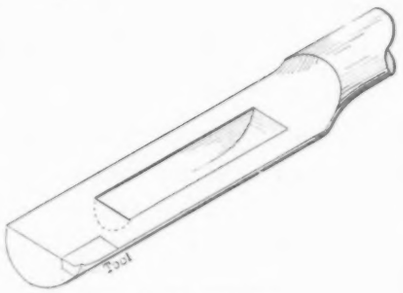


FIG. 22. HOG BIT

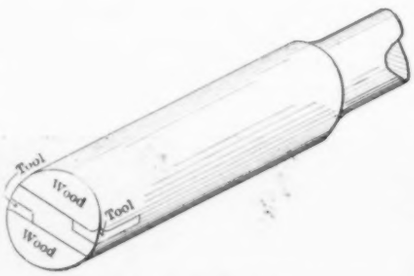


FIG. 23. PACKED BIT

is a flat forging or steel casting with a cylindrical shank, and carries two tools at opposite sides of the front end, the whole affair being built up to the form of a complete cylinder by means of white oak on both sides of the forging. Before using, the packed bit is turned in a lathe in the tool shop, so that the wood is slightly larger than the diameter of the finished hole. The cut being light, and the wood when forced into the hole being under considerable pressure, the bit is held very rigidly. After a bit has finished a job, it is necessary to repack it before it can be used again. The same wood can be used over by putting liners (first paper and then wood) between the wooden segment and the iron frame. After being relined and re-turned several times, the wood of course becomes so thin that it must be thrown away and new pieces substituted.

As the work of boring cannot be done with such accuracy as that of turning, in making a fit the boring is always done first and the male piece is turned to suit the measurement of the hole. An ordinary hoop requires one cut with a hog-bit and two cuts with packed bits, during which

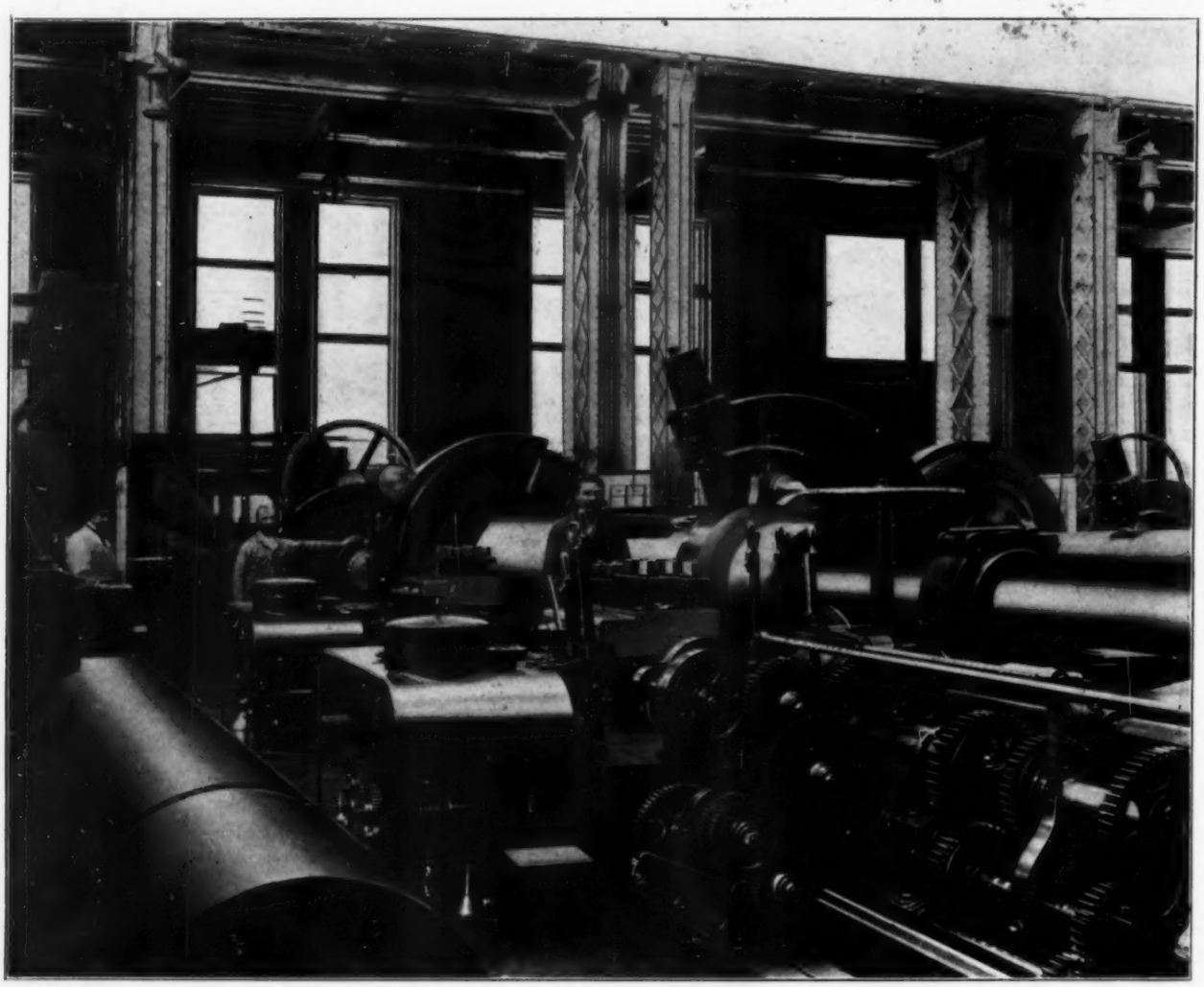


FIG. 24. BORING THE JACKET FOR A 12-INCH GUN

the bits are kept well lubricated with oil. When taking a roughing cut in a gun tube or long hoop, the work when bored half way through is usually reversed in the lathe, in order to minimize the error.

Fig. 24 shows an 88-inch lathe, shop-number 4, boring the jacket for a 12-inch navy gun, the diameter of bore being 22 inches, and the jacket being 34 inches outside diameter, having a length of 10 feet 1 inch. Two cutters are used taking a ½-inch cut with a feed of 0.05 inch, and a cutting speed of 6½ feet per minute. On the same lathe the shrinkage surface is rough-turned with three tools in action at once, taking a ¼-inch cut with a feed of 0.1 inch, and a cutting speed of seven feet per minute.

THE BORE-SEARCHER AND THE STAR GAGE

When the bore is finished an officer examines it with a bore-searcher, which is simply a long rod carrying a mirror placed at an angle of 45 degrees with the axis, and shaded incandescent lamps to illuminate the bore.

A record of the finished diameter of the bore at one-inch intervals throughout its length is obtained by the star gage which is a long sectional brass tube, having at one end a head with three sockets into which are fastened three measuring points. A conical mandrel, when moved endwise, pushes the points out against the pressure of return springs. A rod runs through the tube from the head to the handle end, at which a vernier scale permits the reading to 0.001 inch of the difference, positive or negative, of the diameter measured from the standard ring to which the star gage had previously been set.

After boring the jacket, facing it and rough-turning it, and careful inspection and measurement of the bore, the external diameters of the tube which goes into it are fixed upon, and marked on the "shrinkage-sheet" by the assistant inspector of ordnance. The amount of shrinkage in any particular case depends upon the type of gun, the characteristics of the metal, and upon which layer is in question.

The tube is then rough-turned, bored to within ¼ inch of its finished diameter, faced, and turned to shrinkage dimensions. After bore-searching and star-gaging, it is ready to have the jacket shrunk on.

TURNING

In setting a forging in the lathe, one end, say the breech, is gripped by the jaws on the face-plate, from four to six in number. The muzzle end is held by a pot center, which is a large iron ring with several threaded arms projecting through it radially. The breech and muzzle ends are now adjusted so as to run true, by screwing the jaws in or out, and then, after trying the forging for warping, a cylindrical surface is turned near the muzzle end, and the pot center replaced by a steady rest. At this end a bearing is also bored out, so that a center can be placed in it for the purpose of turning the exterior of the forging.

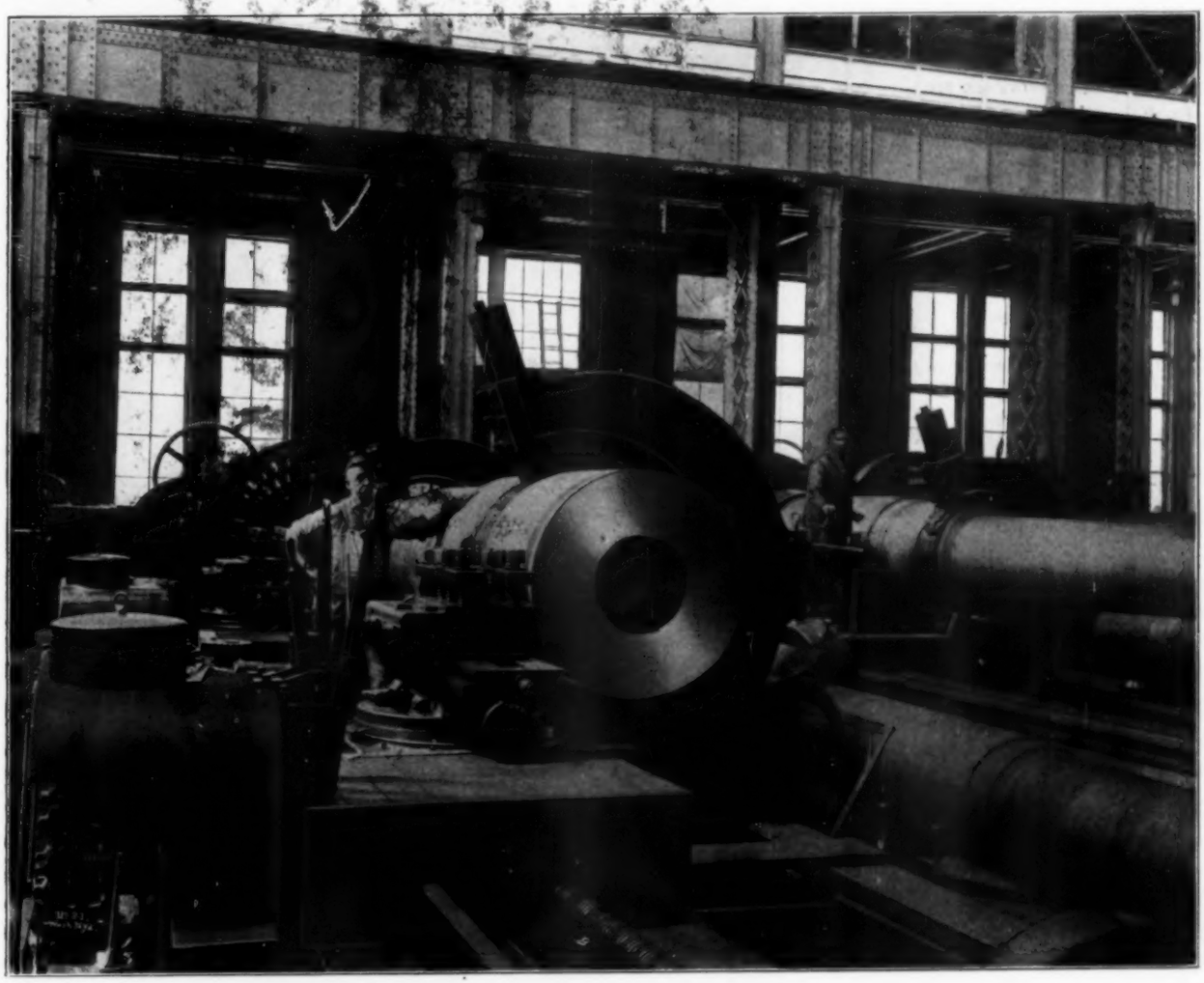


FIG. 25. TURNING THE BREECH OF A 10-INCH GUN

THE BALANCE ROD

During the work of boring, tests are made for the truth of the bore by means of an indicator, which in effect is simply a long rod balanced on a knife edge near its center, the end projecting into the hole being provided with a small roller, which runs on the interior of the bore. Outside the gun is a vertical scale alongside of which the pointer at the outer end of the indicator rod should, if the bore is true, remain motionless, while the work is slowly revolved.

During the operation of turning there may be as many as four tools cutting at once, carried by two or more carriages. The finishing cuts are made by flat-nosed tools from one inch to two inches in width. The diameters are taken by steel snap gages. The blue chip of high-speed tool steel, which has now become such a familiar object in machine shops, is to be seen also in the Washington gun shop.

Fig. 25 shows one of the 88-inch Bement-Miles lathes, finishing the outside of the breech end of a 10-inch gun, having a breech diameter of 42 inches, muzzle diameter of 17 inches and a length of 34 feet 5 inches. The machine is taking a roughing cut, with a depth of ½ inch and a feed of from 0.10 to 0.12 inch, and a cutting speed of six feet per minute. This performance is much exceeded since the introduction of high-speed steel.

THE SHRINKAGE PIT

In the shrinkage pit, which is located where the north gun shop and the south

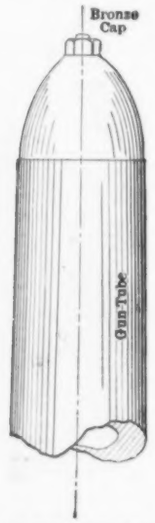


FIG. 26. CAP FOR GUN TUBE WHEN IN SHRINKAGE PIT

gun shop join, and of which a picture was published in the AMERICAN MACHINIST, Vol. 21 (1898), page 333, there are three shrinking wells, located along its south side; one in the center 25 feet deep, and one on each side 44 feet deep, measuring down from the upper side of the shop floor. The guns and jackets are heated in three vertical furnaces, partly seen in the middle of Fig. 16, an independent circular one on each side, and in the center a furnace the hight of which can be regulated by putting on or taking off spare sections. For this latter heating chamber the combustion is effected in a separate combustion furnace, through which air is circulated in pipes and then led by a large pipe across to the furnace in which the gun is placed, either to the top or the bottom, as desired, and the hot air is allowed to circulate around the gun. Pyrometers are provided so as to afford an accurate knowledge of the temperature. The fuel used in these furnaces is crude oil, which is brought to the yard in tank cars.

ASSEMBLING BY THE SHRINKAGE PROCESS

The tube is lifted by the crane by means of a clamping ring at its center of gravity, and placed in the shrinking pit in a vertical position, one end resting on the lower adjustable table and the other passing through the upper adjustable table; and it is brought into a vertical position by the four adjusting screws in the table. Water is circulated inside the tube, entering through the lower end and flowing off through a pipe which runs downward from near the top, the upper end of the gun tube being closed by a bronze cap of the form shown in sketch Fig. 26, which prevents the water from escaping there and also permits the tube to readily enter the jacket.

It takes 30 hours to heat up a large jacket, the temperature being raised very gradually up to somewhere in the neighborhood of 700 degrees Fahrenheit, as shown by the pyrometer. When a long jacket for a 12-inch gun, the shrinking on of which was recently observed, was in the furnace, the pyrometer indicating-tubes from the upper and lower ends of the furnace showed about 800 degrees and 700 degrees Fahrenheit, respectively. The

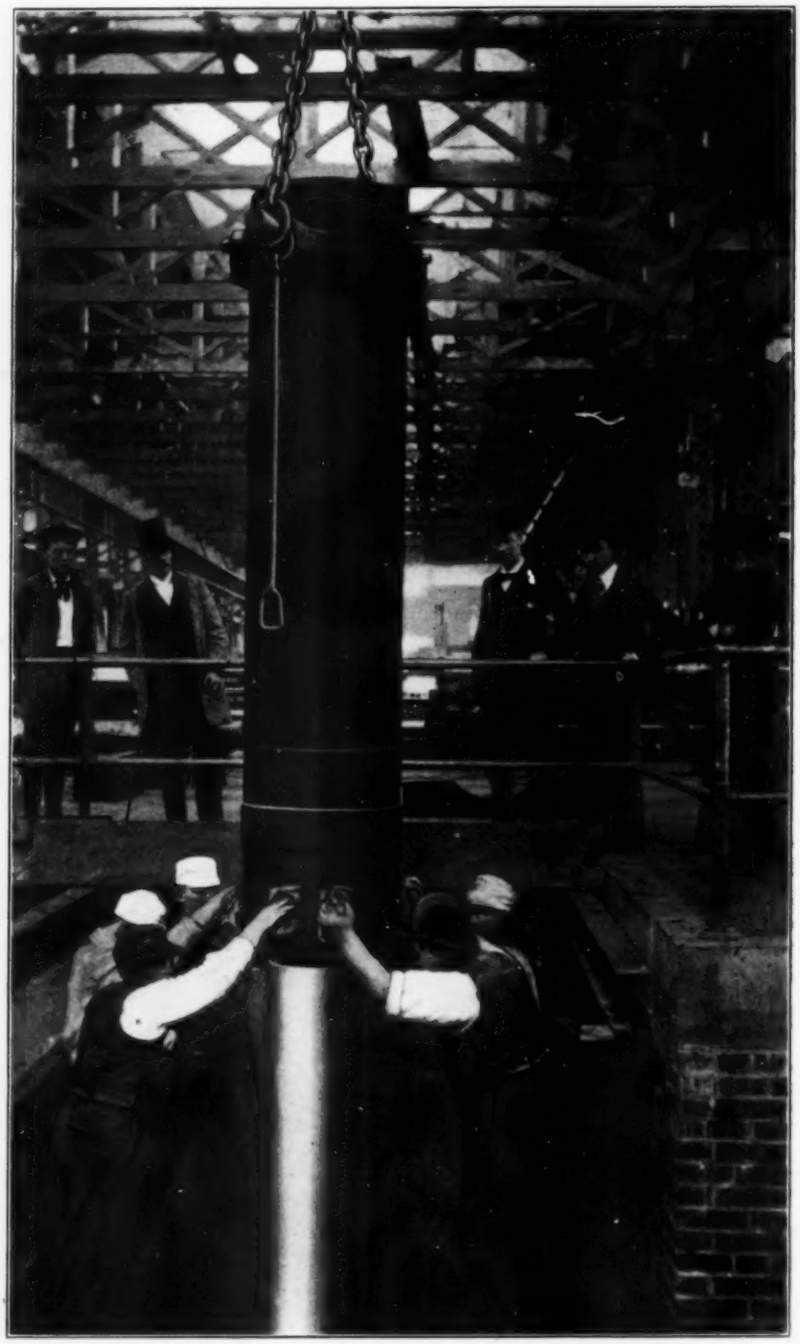


FIG. 27. THE SHRINKAGE PIT; LOWERING A HOOP (THE CAP FOR THE TUBE WAS NOT IN USE WHEN THIS PICTURE WAS TAKEN)

expansion is not permitted to be greater than 0.005 inch for each inch diameter.

The diameter of the bore is measured while the jacket is still in the furnace by lowering steel cross-points into it, the lengths of the "points" being equal to the desired hot diameter of the bore. In the gun-shop office there is a measuring machine which was built at the navy yard with the intention of measuring to within 0.0001 inch, though such a degree of accuracy is scarcely realized by this machine; it is used for measuring points for boring guns, hoops and jackets, and also for turning shrinkages, and will measure as much as 67½ inches. The navy yard has, in the tool shop, a much superior machine made by Pratt & Whitney.

After removal from the furnace, while suspended from the crane by means of a split ring with trunnions, clamped near its upper end, the hot jacket is again measured with cross-points on the ends of sticks, the gager standing underneath it and thrusting the sticks up into it. Different pairs of points are of course used for the different diameters, the gager's assistant standing alongside of him and rapidly handing him one after the other of the gaging sticks as he progresses in the job, which, as may be imagined, is a very warm one with the immense hot tube suspended directly overhead.

Then comes swabbing out, after which the jacket is taken over the tube and as nearly in line with the latter as possible, and is carefully lowered onto the tube, being guided meanwhile, as shown in Fig. 27, by men standing on the platform, and holding pads in hands protected by asbestos gloves, and as it cools it shrinks upon the tube with an embrace which can never be released. After it is cool come more examinations, measurements, and star-gaging.

The chase hoop, which goes on next forward of the jacket, is then bored, inspected and measured, and the exterior diameter of the partly built-up gun is turned to suit. The hoop is heated and shrunk on, and this process is repeated until all the hoops have been shrunk on, the short ones being put on without putting the gun in the pit.

THE BUILDING-UP PROCESS REQUIRES CONSTANT VIGILANCE

From the foregoing description it is evident that during the process of building up a gun the most elaborate precautions are taken in the way of frequent measurements and inspections. If one looks into the principles of the shrinkage process he will see that all this care is fully justified by the importance of the work and the exceedingly serious results of certain imperfections. A gun is practically a gas engine with a piston which escapes from the cylinder at each impulse, and with a maximum working pressure so high (usually considerably over 30,000 pounds per square inch) that the indicator used to ascertain its amount is a solid piece of metal which is compressed by the explosion, and the permanent reduction in its thickness afterward determined by the use of a micrometer, the pressure necessary to produce a given deformation being known from impact tests made on similar pieces of metal. (The matter of thermal efficiency in the case of a gun, however, is regarded in an entirely different light from that in the case of an engine; it would never do to expand the gas down to a low pressure in the effort to utilize all its energy before the projectile leaves the bore. The energy *must* be obtained, even though the gases escape at the muzzle behind the projectile at a high pressure and temperature, and as everyone knows a vast amount of energy is indeed allowed to go to waste in this manner.)

The wall of such a cylinder must have great strength to resist this high pressure, made still more severe by the very short space of time in which it is generated; the cylinder is moreover supported at one point only of its length, and it is important

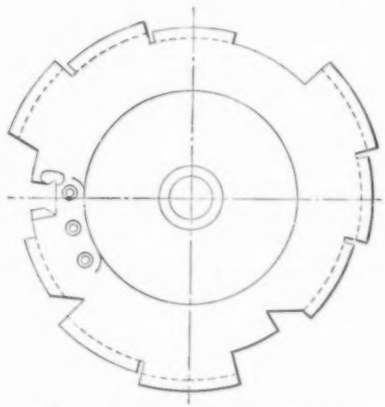


FIG. 28. SHOWING FORM OF WELIN INTERRUPTED SCREW FOR BREECH BLOCK

to minimize its deflection from its own weight, or, as ordnance men say, to avoid "drooping at the muzzle." The process used to obtain a structure capable of fulfilling these conditions, which involves the contraction of metal by cooling from a high temperature, is one which, especially when the size and thickness of the pieces is considered, may result in the production of enormously high stresses, large variations in which depend upon very small differences in dimensions and workmanship of the parts. One naturally thinks first of the stresses acting perpendicular to a longitudinal section of the gun; the stresses parallel to the axis are, however, also of great importance, and it is necessary to keep them down as much as possible. As a hoop contracts on a gun, it at the same time shortens; meanwhile the pressure between the two surfaces keeps increasing, until at a certain point the friction becomes great enough to prevent any further longitudinal contraction. If the hoop at this point is still pretty hot, the result of further cooling is to produce longitudinal stresses within it, which are irregular and practically impossible to compute, the difficulty increasing with the length of the hoop. To reduce premature seizing, it is necessary to have true smooth surfaces, and to heat very carefully so as to avoid warping as much as possible; it is also necessary to see that the cooling is done in a proper manner.

THE OPERATIONS FOLLOWING THE SHRINKING ON OF THE HOOPS

Returning now to the operations in the shop, the assembled gun is put in the lathe, finish-bored, and finish-turned, which may be carried on simultaneously; the muzzle is left rough until a late stage so that the driving jaws may take hold of it.

Next the powder chamber is bored with a hog-bit followed by packed bits, then a boring bar is used for enlarging the diameter inside the chamber, the bar being supported in the bore of the gun. This bar has gearing inside of it for setting the tool out to the proper diameter after it is inside of the chamber. The slots are cut, and the gun again bore-searched and star-gaged.

The jacket, as already intimated, projects back of the tube and forms the screw-box. In guns from four inches to 10 inches inclusive, the interrupted threads are cut in a separate collar which screws into the jacket. The jacket is therefore now threaded at this point.

The bell-muzzle is now finished, and the gun faced to exact length, the tube projecting about ¼ inch beyond the end of the hoop in the case of guns hooped to the muzzle, as is now being done on all large guns.

CHASING THE INTERRUPTED SCREW-THREADS IN THE BREECH

In cutting the Welin interrupted screw thread (see sketch Fig. 28), the segments are laid out on the collar, and are then cut by the slotting machine in the north end of the gun shop. A special head is used for cutting the interrupted thread itself; and when one approaches the lathe where this is in use, he is inclined to remark, "It certainly sounds like an interrupted thread," for when the cutting tool comes to the end of a section of thread it quickly—and loudly—snaps back to the next smaller radius under the action of strong springs which hold it against the cam inside the head. This motion must of course occur while the small gap between segments is turning past the tool, and the sudden prompt movement, coming after the slow thread chasing, is decidedly an interruption. The gap, in the breech of a 12-inch gun, measures ¼ inch, the maximum thread radius 11½ inches and the minimum 10 inches. The cam inside the chasing head is revolved by shafts and gearing connected to the feed shaft of the lathe. This breech-block thread is sometimes right-hand and sometimes left-hand. In the case of turret guns, where there

are two guns in a turret, the threads of the two breeches are opposite in hand, as this makes for convenience in operating the guns.

RIFLING

The production of rifling involves some interesting processes. It is necessary to have a rifling bar (the analogue of a boring bar), which is constructed as follows: A development drawing of a single groove of the rifling is made, and one edge of a flat cast-iron plate made to conform to this curve. The curve is then transferred to the cylindrical surface of a rifling bar, by mounting on the latter a pinion which gears with a rack, the rack being arranged with reference to the cast-iron plate so that it stands in the same relation to it as the cross slide of a lathe does to the taper attachment. As the bar travels longitudinally past a cutting tool in the rifling machine, it is given slow partial rotation by the movement of the rack on the rifling plate, so that the groove cut in the rifling bar is of the desired curve. Other grooves of different forms can be cut in the same bar if desired.

THE RIFLING MACHINE

The rifling machine is arranged so that the production of a rifling bar just described can be accomplished on it. The part of the rifling machine which carries the gun (illustrated at pages 331 and 332, Vol. 21, 1898) does not look like much of a machine, all one can see being merely two long strips in the floor with T-slots, and resting upon them three steady-rests with adjustable jaws, in which the gun is supported so that its axis will be in line with the axis of the rifling bar. The rifling machine proper is located at the end of the gun when the latter is in place, and consists of a bed resembling that of a lathe, supporting three carriages or rests, through which the rifling bar passes. The forward one of these rests, that is, the one which is nearest to the gun, is fixed, and from it and extending back to a point half-way between the front and the rear supports is a bronze semi-cylinder, in which the rifling bar rests. The back end of the rifling bar is carried by the rear carriage, which is fed forward by the lead screw in the center of the bed, being provided with a nut for this purpose. It is thus seen that while the front support is stationary, the back one moves forward at the same speed as the bar. The intermediate support or carriage is caused to travel forward at a reduced speed by the following mechanism: Fig. 29 is a diagram made from a free-hand sketch showing the arrangement of gearing of the middle support. This is supposed to be a transverse section looking forward, that is, looking toward the gun. *A* is the lead screw; *B* is a worm wheel on a short horizontal shaft and is driven by *A*; *C* and *D* are bevel gears, the latter being on a short vertical shaft, carrying on its lower end a pinion which meshes with a fixed rack extending from the front end of the bed to its middle. It is very evident from this that the revolution of the lead screw will cause the middle carriage to be fed forward along the bed, during which movement the bronze semi-cylinder already mentioned slowly passes backward through the support; the rifling bar moves forward still faster, while the head on its forward end is engaged in cutting the groove in the bore of a gun.

Upon the back end of the rifling bar is a pulley, to one point of the circumference of which is attached the end of a piece of belting. This belt runs around a considerable arc of the circumference and then over another pulley on a movable stand and down to a weight hanging at its free end. The result of this arrangement is, of course, to tend to rotate the bar in a certain direction, and thus by means of the pinion and rack already described to keep the transverse slide against the cast-iron rifling plate, from which the form of the curve is transferred to the boring bar, as already described.

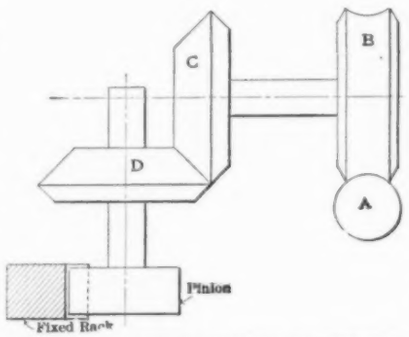


FIG. 29. SKETCH OF GEARING IN RIFLING MACHINE

THE RIFLING HEAD AND CUTTING TOOLS

Having a rifling bar with the proper groove cut in it, a rifling head is mounted on its forward end, carrying the cutting tools for producing the grooves in the guns. Four cutters placed at 90-degree spaces are used; at the end of the head are the projecting square ends of screws to permit of adjusting the cutters separately to radius, and there is also a tapered sleeve by the longitudinal motion of which all the cutters may be jointly set in or out. The gun is placed on the steady-rests with its muzzle pointing toward the machine.

The front support of the rifling bar has at its top a stud or pin, engaging with the groove in the rifling bar, compelling the latter to rotate as it is fed forward into the gun, so that each of the cutting tools describes a curve which is an exact duplicate of the curve of the groove in the rifling bar; that is, it is a helix or a modified helix. The cutters are of the same section as the grooves to be cut. At each traverse of the bar only about 0.002 inch cut is taken, so that it is necessary to have from 15 to 30 cuts to get the full depth of the groove. The cutters are kept well lubricated with oil. As there are four of them, of course, four grooves are cut at once. The portion of the rifling head which carries the tools is separate from the part fixed to the bar, being capable of being revolved upon the latter by means of a worm and worm-wheel. An index ring is provided, having 72 holes; therefore, after the completion of four grooves, it is a simple matter to index the head around and cut four more grooves. This is repeated until all the grooves are cut.

After finishing the primary rifling, in cases where the width of the groove varies, the guide pin is shifted to a secondary slot in the rifling bar, and the extra width of groove at the breech end is cut.

LAPPING THE BORE

After all the grooves of the rifling are cut, the gun is placed on skids at the lapping machine, which is a simple affair but quite sufficient to do the business. It consists merely of a lapping head on an endless wire rope, which passes through the bore of the gun, and around sheaves at each end. The sheave at one end is arranged to be driven by a shifting belt mechanism, similar to that of a planer, the dogs of the planer table being in this case replaced by blocks clamped on the endless wire rope, and at the end of the traverse these blocks strike the arms and cause the motion of the sheaves to be reversed, so that the hauling back and forth of the lapping head is done automatically. First the grooves are lapped by drawing through the gun a head bearing four copper groove laps, fine emery and oil are used, and the process is kept up until all the grooves have been lapped. Then the lands are lapped by a semi-cylinder of lead, and the bore is finally polished with a burlap cylinder.

Once more the bore-searcher and star gage are brought into use, the latter being applied both to the grooves and to the lands.

FITTING THE BREECH MECHANISM, YOKE, ETC.

At the north end of the gun shop are several dummy gun breeches, which are used for fitting breech blocks. This reduces the amount of work required in fitting the block to its own gun. In the breech-mechanism shop there is a horizontal boring, drilling and milling machine with a steady-rest, in which a gun may be supported, being carried by a ring revolved by an electric motor. This makes it easy to revolve the gun so as to present different points of the breech opposite the drill or the milling cutter, which removes the metal in making the hinge in the breech.

The forged-steel yoke (referred to at page 104) is put on the gun, and when completed the gun with its breech mechanism is weighed and the weight stamped on the breech end.

After the final inspection and marking.

the gun is placed in its slide, and all made ready for proving, and it is then sent to the proving ground on the Potomac river, at Indian Head, Maryland; in this process, five shots are fired and the gun is then returned to the navy yard, where it is again lapped, cleaned, bore-searched, and star-gaged, and the sights are fitted and adjusted. After all is right, a coating of white lead and tallow is applied to the bore, and heavy oil to the outside, and the gun is shipped or is sent to the storehouse.

Including the yokes, breech mechanisms, accessories and spare parts, a 12-inch gun costs on the average, approximately $65,000; an 8-inch gun, $25,000, and a 6-inch, $13,000.

An Abuse of the Patent Privilege

BY IRVING D. KIMBALL

A country is benefited by a patent-granting act because the benefit to a patentee is a spur to continual activity toward better conditions. The Constitution of the United States provides that Congress shall have power "to promote the progress of science and useful arts by securing for limited terms to authors and inventors the exclusive right to their respective writings and discoveries." In return for an exclusive use to his invention for a term of years an inventor must relinquish that right to the public at the end of the term, thereby benefiting the country which has benefitted him. For this reason it is for the good of all that an invention should pass as quickly as possible through the stages which precede the beginning of the limited term of exclusive use.

With all honesty to his fellow men and to the country which is thus benefiting him, an inventor should carry through with despatch his invention from the time of its conception to the time of the issuance of a patent. Much less should an inventor intentionally and wilfully prolong this time as much as possible. The courts and patent office realize this, and take advantage of every opportunity to decide in favor of the inventor who uses diligence, and against the inventor who is trying to clog the wheels of progress as much as possible, to his own advantage. Of course, cases differ, and many times an invention requires a large amount of time in going through the various stages; and it is because the rules must be sufficiently broad to protect such cases that the less scrupulous inventor can take advantage of them.

RULING THAT THE FIRST TO REDUCE TO PRACTICE IS THE FIRST INVENTOR

It has become common for the patent office to rule that of two claimants for the same invention the first inventor is the one who first reduces the invention to practical operation, although he may have been much later in his conception. An inventor must display reasonable diligence in reducing his invention to practice if he is to expect the protection of the patent office and the courts. This may be clearly illustrated by the following brief abstracts from decisions which are but examples of many along the same lines:

"Where P. conceived the invention in 1891 and did nothing with it but talk of it and make drawings of it until 1896, and where J. entered the field in July, 1895, and was the first to file his application. Held that J. is to be regarded as the first inventor. 106 O. G. 2013."

"Where L. claims conception in March, 1900, and reduction to practice in December, 1900, and W. proves conception and reduction to practice in July, 1900. Held that W. must be regarded as the first inventor in the absence of a showing that L. was diligently engaged in perfecting his invention. 107 O. G. 832."

A DELAY OF ONE YEAR PERMITTED

After application for a patent has been made, and the case has been examined by the office, the applicant has one year after each action of the office in which to file a reply. If no reply is made within the time allowed, the case is held to be abandoned unless it is clearly shown that delay was unavoidable. This term was formerly two years, but was reduced to six months in April, 1897, because inventors were taking advantage of it to prolong the life of their patents. However, it was found that in difficult cases six months was a real hardship to the applicant, and the period was changed back to two years in June, 1897. Later in 1897 it was reduced to one year, where it has remained.

To give some idea of the extent of this practice of keeping an application alive, it may be mentioned that in the report of the commissioner of patents for 1894 the following history of the actions in an application still before the office was given as illustrating the extent to which this evil is sometimes carried:

Application filed, June 23, 1879.
Rejected, July 21, 1879.
Specification and claims amended, June 10, 1881.
Rejected, June 22, 1881.
One claim amended, May 2, 1883.
Rejected finally, July 27, 1883.
One claim canceled, July 24, 1885.
Rejected, July 30, 1885.
Three claims amended, July 22, 1887.
Rejected, January 6, 1888.
All the claims amended, June 5, 1889.
Rejected, July 2, 1889.
Argument and amendment to two claims, June 23, 1891.
Rejected, August 26, 1891.
Argument and amendment to one claim, August 21, 1893.
Rejected, November 1, 1893.

It can be seen that the office action in almost every case was very prompt, while reply by the applicant was delayed in almost every case until a few days before the expiration of the two years' period, which was then in force. In the commissioner's report for the next year he mentions the fact that on December 31, 1895, there were before the office awaiting action by applicants, 1398 cases which had been pending five years or more, 92 cases which had been pending ten years or more, and 31 cases which had been pending fifteen years or more. Sometimes an attorney will keep an application in the office as long as possible in order that he may be able to charge for a larger amount of time or because he realizes that a patent cannot be obtained and shrinks from telling the applicant the truth for fear his reputation will suffer, hoping, perhaps, that the applicant will die before the case is settled, as is not at all improbable in some cases.

RESULT OF OVERRUNNING THE TIME LIMIT

The office is always quick to deal peremptorily with an applicant who waits until the next to the last day or so of the term, after every action of the office, and at last misses by a day or two. The following brief abstracts from recent decisions will clearly illustrate this fact:

"Where a party intentionally postpones proper action until the last of the time allowed, he assumes all risks from accidents, mistakes, and other circumstances which may then prevent action. 96 O. G. 2410; 1901 C. D. 137."

"Where the applicant postpones action until what he supposes is the latter part of the time allowed him, and he then discovers that there was a mistake in his records and the time has already expired. Held that although the mistake may have been unavoidable the delay was not unavoidable, and the case is abandoned. 109 O. G. 1608."

"Where amendment is delayed until the last of the year allowed by law, and is not received in the office until after the year, the fact that there was a delay in the mails will not be sufficient to warrant revival. 16 Gour., 74-24."

Another reason why an unscrupulous inventor may desire to prolong the life of an application as long as possible is that after a thing has been in use a great number of years without a patent appearing for it, people are apt to assume that no patent has been applied for, and begin manufacturing it, to their future sorrow and the delight of the inventor.

An inventor is entitled to his seventeen years of exclusive use, but when he purposely drags out his application proceedings five of ten years he is deliberately stealing those extra years from the public.

Four hundred thousand pounds of obsolete German pennies, of about the same proportion of copper and tin as used in high conductivity electrical castings, have, it is said, recently been purchased at 21 cents a pound by manufacturers, being cheaper now than electrolytic copper.

TEST OF THE POWER REQUIRED TO DRIVE TWIST DRILLS*

A Diagram for Finding the Power Consumed in Drilling Cast Iron

BY C. S. FRARY AND E. A. ADAMS

As a result of the recent experiments with high-speed drills it was found that the thrust necessary to push a drill through a piece of metal was very much greater than had been supposed. Hence it would be necessary to build very much heavier and stronger machines in order to use the drills up to their full capacity.

Two years ago the Worcester Polytechnic Institute, in accordance with this fact, designed and built a new 16-inch drill press. The machine as it is now standing in the shops of the institute, consists of a box-shaped upright post somewhat similar to the parabolic posts of the latest planers. The spindle is driven by a steel miter gear meshing with a rawhide gear. There are four belt speeds ranging from 328 to 525 r.p.m. The feeding mechanism is the

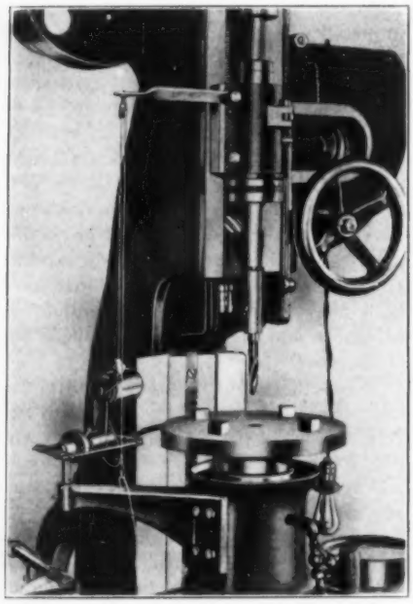


FIG. 1. TWIST-DRILL DYNAMOMETER

weakest point in the whole construction of the drill press. It consists of a chain drive from the jack shaft, to a large sprocket, which is connected to a cone of gears by means of a universal joint actuating a small gear, which can be shifted from the lowest step of the cone to the highest, thus giving a range of feeds from 0.0045 to 0.0225 inch per revolution of the spindle. The drill is so designed that at the end of the hole which is being drilled a reversing clutch is thrown in and the drill will be drawn out of the work. As the drill was finally built the quick return ratio was about 6:1 at the highest feed and 29:1 at the lowest. It was designed for a return speed of 0.225 inch per revolution of the spindle. In other figures the return speed was about 112 inches per minute or about 2 inches per second. The machine was actually built and run with that return speed. The only trouble experienced was that the spindle after reversing, instead of stopping, threw in the feed clutch and started to feed into the hole which it had already drilled. Outside of the few things mentioned the drill press was a very strong machine and behaved extremely well under the severe test to which it was subjected, during the few twist-drill tests which could be made in the limited time at the disposal of the experimenters.

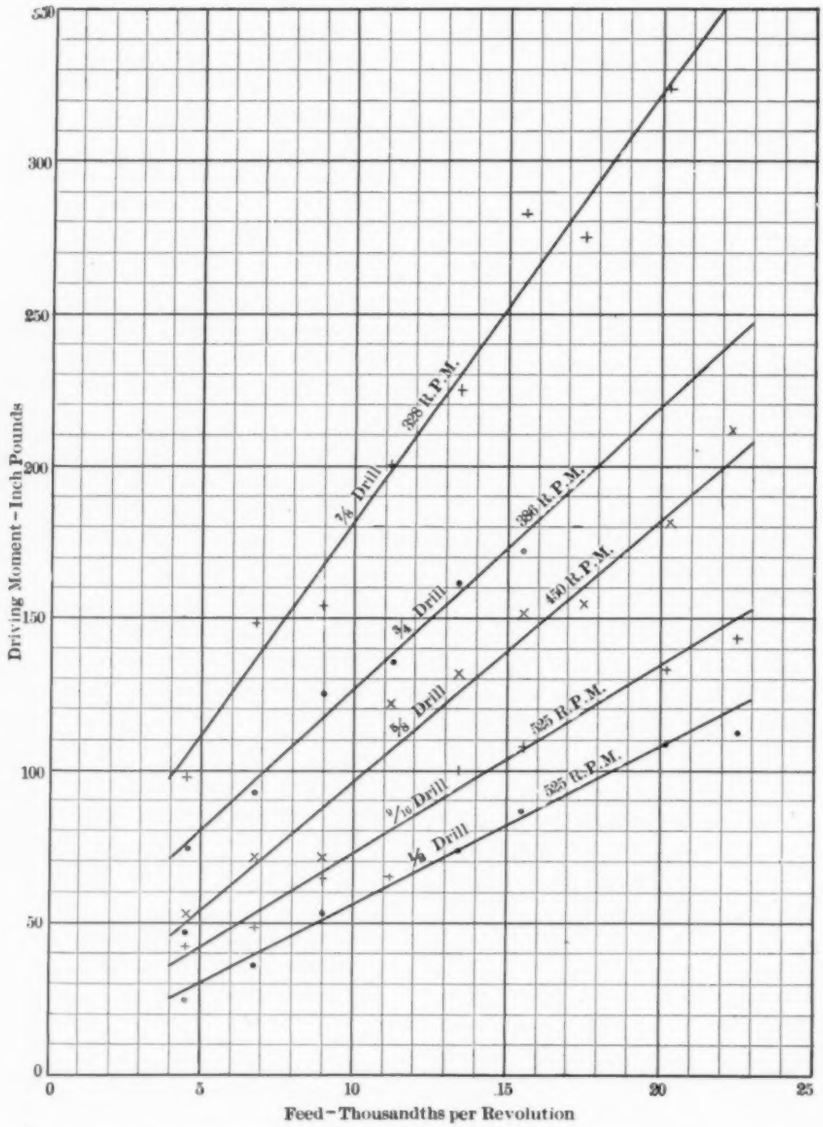


FIG. 2. RELATION OF MOMENT TO DIAMETER AND FEED, ANGLE OF LIP 59 DEGREES

THE DYNAMOMETER

The dynamometer (Fig. 1) for registering the thrust and the twisting moment of the twist drill, was very simple and efficient. A hollow piston with a round top to form a table, was scraped to fit a cast-iron cylinder. The cylinder was filled with heavy cylinder oil, and had an ordinary pressure gage tapped into the lower end. The gage read pressure per square inch and in order to get the thrust of the drill it was necessary to multiply by the area of the piston which was about 20 square inches. To measure the twisting moment a steel band, fastened to the enlarged top of the piston, was connected to an indicator spring by means of a steel rod screwed into the bottom of the indicator piston. Since the area of the indicator piston was only ½ square inch, and

* From the *Journal* of the Worcester Polytechnic Institute.

the force was applied direct in this case, the indicator spring had to be rated at ½ its usual value when used in a steam indicator. The movement of the drum of the indicator was obtained by passing a cord over a pulley, which was attached to the carriage of the spindle, and then fastening the end to a projecting arm on the dynamometer. Taking the average force as registered by the indicator diagram and multiplying by the radius of the round table gave the twisting moment. In none of the tests did the moment exceed 350 inch pounds, which was obtained with a ⅞-inch drill running at a speed of 328 r.p.m. and feeding 0.0225 inch per revolution.

In order to be sure that the thrust given by the dynamometer was correct a calibration curve was found by applying loads on the piston of the dynamometer and reading the pressure recorded by the gage. Every reading of the thrust during the drill tests were corrected for static friction in the dynamometer by referring to this calibration curve.

THICKNESS OF DRILL WEB

During tests made by Prof. W. W. Bird and Mr. Fairfield, in 1904, it was found that there was a great variation of zero diameter and assuming a thickness of web equal to 1-64 in., the thickness of web should increase 1/64 inch for every increase of ⅛ inch in the diameter of the drill.

In all of the tests made this law was followed as far as possible. Drills made of Novo steel were used varying from ½ to ⅞ inch by sixteenths, and as far as they could be obtained conformed to the law proposed by Mr. Fairfield.

Among the many possible tests which could be made with twist drills only a few were taken up. All tests were made on fairly even hardness throughout the entire length of the specimen. Before making a test each specimen was tested for hardness by drilling a ⅝-inch hole and stopping the drill just below the surface of the specimen. The pressure registered by the gage was taken as an indication of the hardness of the specimen.

A test consisted of drilling three holes for each of the nine feeds at a constant surface speed of the drill of about 70 feet per minute. Three specimens were chosen of the same relative hardness and one hole drilled in each for the different feeds, and

No. of Test.	Diameter of Drill.	Thickness of Web.	Angle of Lip.	Hardness of Test Piece.	Speed.		Thrust—lbs. for Feeds in Inches per Revolution.							
					R.p.m.	Ft. p. m.	0.0225	0.0203	0.0176	0.0156	0.0135	0.0113	0.009	0.0068	0.0045
16	⅝"	0.078"	59°	15	525	66	1142	995	832	738	640	576	454	405	320
17	5/8"	0.086"	59°	15	525	74	1540	1363	1192	1020	860	732	618	476	370
18	⅞"	0.093"	59°	15	450	72	1180	1079	916	817	738	668	582	497	405
19	13/16"	0.098"	59°	15	386	68	1296	1130	935	778	700	643	515	466	373
20	¾"	0.104"	59°	15	386	71	1218	1075	914	820	735	850	585	508	416
21	⅞	0 ..5 '	59°	15	328	73	1543	1405	1260	1110	963	849	742	635	529

VARIATION OF THRUST WITH DIAMETER OF DRILL.

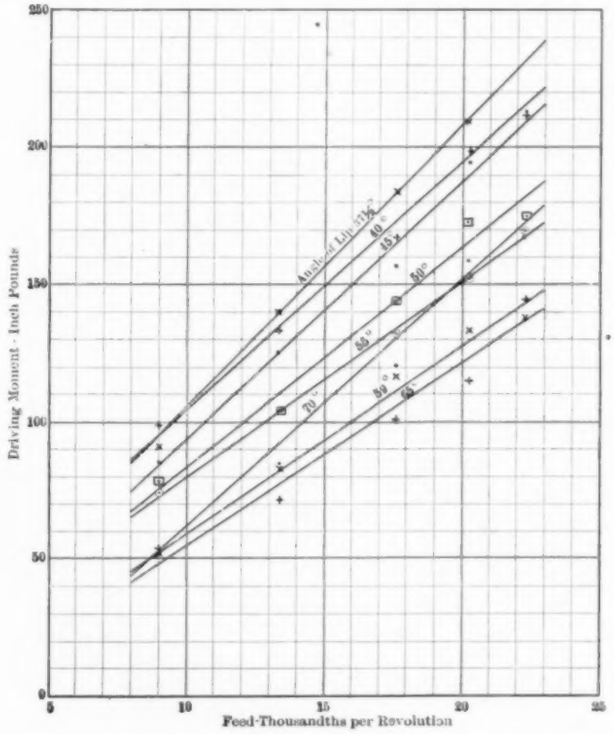


FIG. 3. RELATION OF MOMENT TO ANGLE OF LIP AND FEED, DIAMETER OF DRILL ⅝ INCH, SPEED 450 R.P.M.

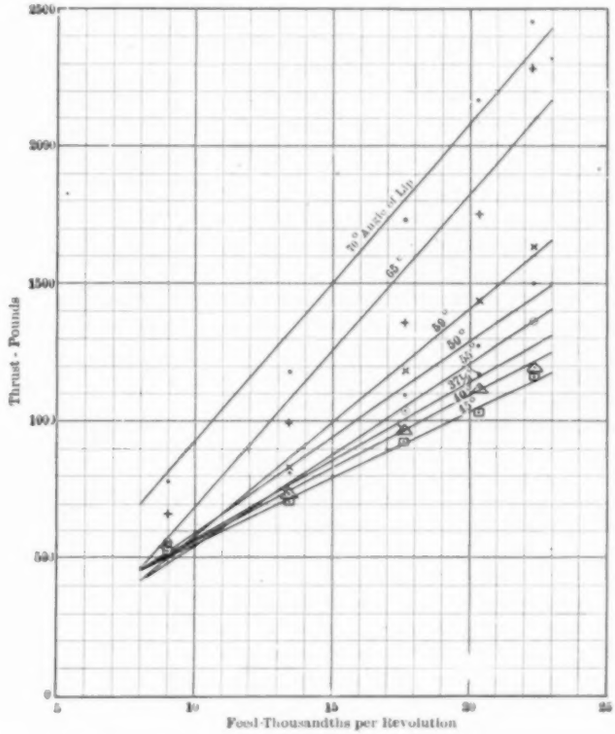


FIG. 4. RELATION OF THRUST TO ANGLE OF LIP AND FEED, DIAMETER OF DRILL ⅝ INCH, SPEED 450 R.P.M.

the thrust obtained from drills of the same diameter working under the same conditions. On measuring the thickness of the web of the drill they were found to vary quite widely for the same diameter of drill even among drills of the same manufacture. After considerable study Mr. Fairfield deduced from common practice the following law: Beginning with a drill of

cast iron, keeping the surface speed of the different-sized drills as nearly constant as the four speeds of the drill press would allow, and changing the feed.

THE TEST PIECES

The test pieces were 10x2x1½ inches poured horizontally, being gated at three places on one side. This was to insure a

readings of thrust and twist being taken for each. This was done for all of the drills and formed one part of the experiment.

All of the above tests were made with a constant angle of the lip of the drill of 59 degrees. Several tests were made with a ⅝-inch drill by keeping the speed constant and varying the angle of the lip

from 37½ to 70 degrees, and measuring the thrust and moment for the nine different feeds.

GENERAL CONCLUSIONS

As a result of these tests there are several interesting conclusions. In all the tests where the speed was kept constant the thrust was very nearly proportional to the feed.

With a constant surface speed the thrust is very nearly proportional to the diameter of the drill.

With the different angles of lip the thrust decreases from 75 down to 45 degrees, and then increases for any further decrease in the angle. The moment is quite different. In fact it cannot be said that the moment is in any way proportional to the angle of the lip although it is nearly proportional to the feed.

From a study of the variation of the thrust with the angle of the lip it would appear that the 45-degree angle ought to give the best results in practical machine shop work. There is only one instance, known by the experimenters, in which the 45-degree angle is given the preference over the older angle of 59 degrees. That is in the case of William Sellers & Company, Philadelphia.

RESULTS OF THE TESTS

[Instead of reproducing the tables of results we have converted the most significant of them into diagrams, of which Fig. 2 shows the variation of the twisting moment with the diameter of the drill and the feed, the results obtained with the 11/16-inch drill being, however, omitted as they were erratic. Fig. 3 shows the variation of the twisting moment with the angle of lip and the feed.

The best results as regards moment will be seen to be obtained with an angle of 65 degrees, although the customary angle of 59 degrees lies close to it. Other angles, whether larger or smaller than these, involve an increased moment.

Fig. 4 shows the variation of the thrust with the angle of lip and feed, the best results as regards thrust being obtained with an angle of 45 degrees, other angles whether larger or smaller, involving an increased thrust.

The results of the experiments on the thrust as related to the diameter of the drill, are so erratic that we have not attempted to plot them, but give the original table instead.

A WORKING DIAGRAM

If the lines of Fig. 2 be averaged, as the observations have been averaged to obtain the lines, we may construct the diagram of Fig. 5 by which the moment required to drive a drill may be determined. Thus for a ¾-inch drill at a feed of 15 thousandths per revolution, raise a perpendicular from the intersection *a* of the size of drill, and the 15 thousandths feed lines to the observation line. To find the hight of the intersection, *a b* may be taken in the dividers and compared with the vertical scale of moments, or we may follow one set of diagonals to *c*, and the other to *d*, and there read 195 inch pounds.

As it is always permissible to use the results of a set of experiments somewhat beyond their actual range, we have extended the diagram in dotted lines to include drills up to 1⅛-inch and feeds up to 30 thousandths—the full line portion of the diagram representing the field of the actual experiments, and the dotted portions the extensions. The length of *e f*, obtained by the dividers or by following the diagonals as before, shows the moment for a 1-inch drill under a feed of 25 thousandths to be 476 inch pounds.—ED.]

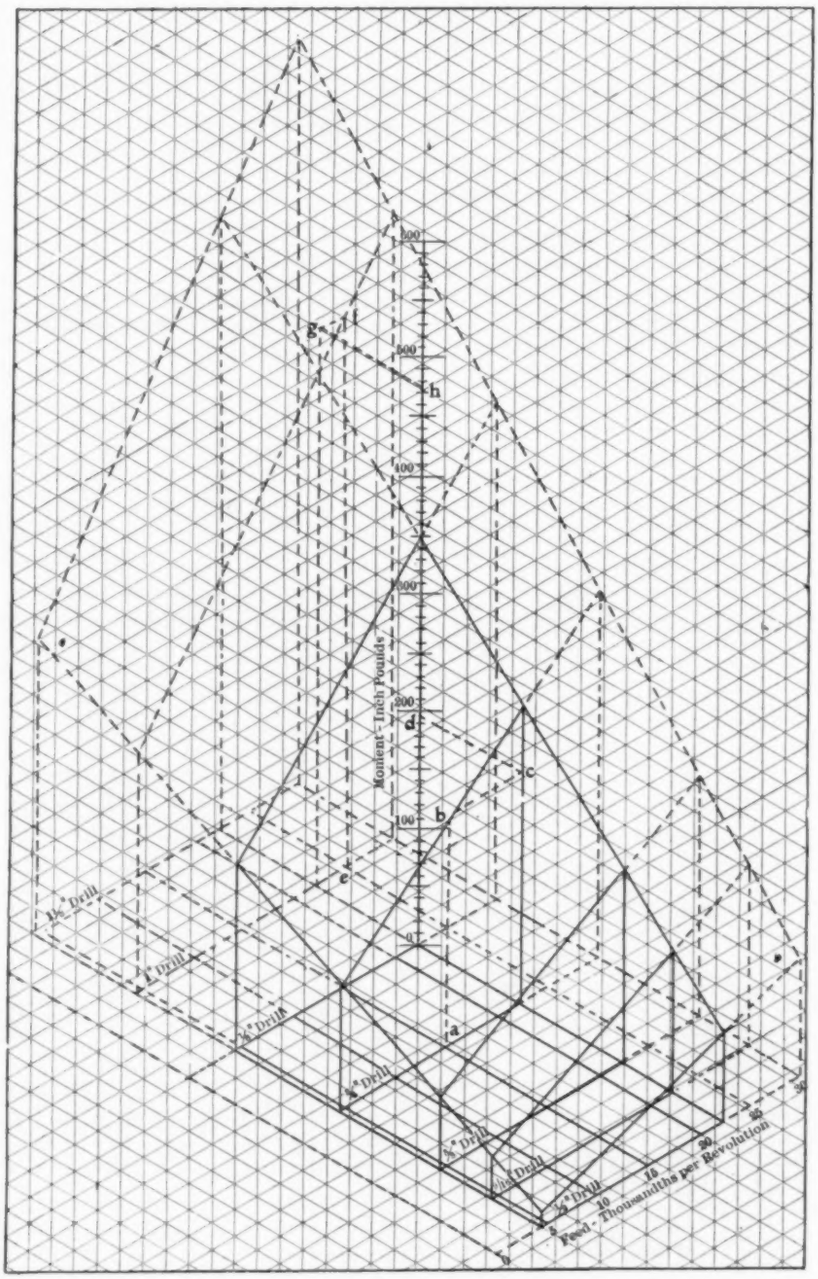


FIG. 5. DIAGRAM FOR FINDING THE POWER REQUIRED TO DRIVE TWIST DRILLS IN CAST IRON

Barnum & Bailey Adopt the Automobile

Another application of the commercial self-propelling vehicle is in sight. According to recent reports it is to be utilized by the far-famed Barnum & Bailey circus, so that the familiar endless trains of showy cars which one used to wake up some morning and find filling the railroad sidings will become a thing of the past, so far as this show is concerned, at any rate. It will, of course, be expensive to carry all this outfit on automobiles, but so was the railroad transportation expensive. This will probably enlist another strong advocate in the cause of good roads.

Sammy's Shop—Elementary Lessons in Financing a Machine Business

When Sammy first got his shop, times were dull and work was scarce and what was being done was divided among the shops, but soon things began to look up and the other shops began to turn the little jobs away. The demand for their regular lines began to come in and they did not like to be interrupted doing odd jobs. It was well for him that this was so. He had been long enough in the business to find that his net profits were painfully small in spite of all his efforts. He was not trained to business methods. While he was a good workman he did not understand the intricacies of finances, but when the books began to show that, after he paid wages and rent, and for material and supplies, the money that the work brought in did not leave him very much for wages for himself, it made him do some very hard thinking.

ACCOUNTS EXAMINED

At first he was inclined to think that there was something wrong with the bookkeeping, but after spending several evenings going over it with Mary, he concluded that it was all right.

This going over the accounts had one good result. It set him to thinking about things in a new way. He began to see that there was an inseparable relation between the work done and the shop expenses. It was different in some ways from the relation between the work and wages paid to the man doing it, but none the less positive and unavoidable for all of that.

If Sammy had seen all of these things before he took hold of the shop I do not think he would have touched it. The main reason that he kept hold of it was that he was in the position of the Irishman who was holding the wildcat. He wasn't pleased with the job of holding it, but he did not know how to safely let go of it.

CHARGING FOR WORK

Gradually several ideas filtered through his brain. One was that charging for a job by the time used in doing it was not always the best way or even a logical way. The value of the job to the man getting it, and the degree of knowledge required to do it was often a better basis. One thing that Mr. Davis had impressed upon him was that everything should be well done, and in case of doubt it was better to keep on the side of doing it too well. When Sammy protested that it cost more to do it too well he still kept his ground. "If you always do good work you can charge any reasonable price for it, and sometimes an unreasonable one, and still keep the trade; but if you do a man a poor job he will never forget it. He will have it in for you no matter how cheap it was. It keeps bothering him as long as he has it. If you give him a good job he may think the price is a little high at the time, but if the thing works all right he forgets all about the high price, or else sees that it was not high considering the quality. It does not take much trouble to more than make up for any difference in cost of work done at different places." Experience proved that he was right.

THE MORE EMPLOYEES THE BETTER

Another idea that began to show up was that the more men he had working for him the better, and that the percentage of profit increased also with the number of men. It was not at first clear why this should be so, but he gradually began to understand that he had certain fixed expenses which did not change with the number of men or the amount of work which he had in the shop. Of course, he always knew that he had to pay rent and buy coal, but at first he did not connect such things directly with each job.

It may look as though he was rather thick-headed, but it has been said that there are yet some much more pretentious establishments in this country which have not learned it, and that there are men, experts, who make it a business, at a remunerative figure for themselves, to work out and make clear this very relation.

THE MONEY QUESTION

Another thing that began to be very clear was that it took money to run a business, and quite a lot of it. Work was not paid for until after it was done, and the customer had got it, and often not then, but wages had to be paid when Saturday night came. Material could not be charged for until it was worked up into some job, but it had to be kept on hand for prospective use, and the man who sold it could not wait indefinitely for his money. Work had to be done for good customers when it was sent in even though the account had to be carried for a time.

DOMESTIC ECONOMY

With the closest economy some money had to be provided for the family even when they lived more closely and dressed more poorly than any man who worked in the shop.

Mrs. Sammy had a much keener insight into many things than did Sammy. Long before he had seen what owning a shop was going to mean she had seen it, and had cheerfully given up many pleasures on account of the cost. When Sammy would mention going to the theater or some other place of entertainment, she would have some very good reason to give why it would not be convenient to go at that time, and he being only a man did not see that the money was the controlling reason. A ramble in the country on Sunday afternoon was nearly the only recreation that she thought they could afford.

A CUSTOMER'S NOTE

A customer, paying for some work where he had been without the ready cash, gave a note with the statement that it could be discounted at one of the banks, and, as pay-day was at hand and the money to meet it was not, it was taken there. It will be understood that, in an oil town with a large floating population, and the rest of the people in a more or less unsettled condition, bankers look well to their security. A man may be on the top today and down out of sight tomorrow, and it takes quite a trying out to determine just what a name on a paper stands for. This banker listened to Sammy's story, for he told all about how he needed the money to pay his men, and discounted the note without comment.

THE BANKER VISITS THE SHOP

As time went on Sammy found it necessary to apply for money on his own note, for, come what would, pay-day for the men must be met. He had asked for it the day before it was needed, and had been told that they would let him know in the morning, that money was a little tight, and might not be available unless someone came in and deposited some, etc.

A little after banking hours Mr. Berton, the banker, came strolling in. "I was just going by and not being in a hurry I thought I would give you a call. I have often thought of doing so as I have been going by, but generally seemed to be in too much of a hurry to do it. As I have some oil property I may need some work done myself some day, and I would like to see how you are prepared to take care of it."

THE MACHINIST AND THE FINANCIER

Sammy did his best to impress the meager facilities of the shop in a favorable light on his guest, and told how he was always willing to keep going long hours to take care of everything that came his way when the regular hours were not long enough. Incidentally, he explained that it was the very volume of work that made it necessary for him to apply for the loan.

To show the truth of his statement he showed the accounts on his books, and to explain their neatness it was necessary to tell of the part that Mary was taking. A question now and then from an interested listener is a wonderful encouragement when a man is talking about the business that is taking all of a man's time and attention, and Sammy was never sure of all he did say before he stopped. The fact that Mr. Berton told him that the money he needed would be ready for him the next day may have had something to do with sending his mind into channels that were new, for after that gentleman had gone he found himself wondering if it would be possible to get enough money advanced to enable him to work a couple of additional hands. Knowing how little he had that he could call his own, he did not feel free to mention it, although Mr. Berton came in quite often and sent in some work.

A SUGGESTION

On one of his visits he said to Sammy: "If you were to get out and hustle a little I believe that you could fill your shop full of work, and use as many men as you have room and tools for."

"I believe I could, too, but I don't know where to get the money to carry me until I would get it coming back again. You see, I came in here with almost nothing, and have had to do the best I could. I am gradually getting ahead. Once one boy was all that I could keep at work, but now I have a man, and part of the time, two. I have lots of work, but it is the money end that bothers me."

THE BANKER'S BUSINESS

Sammy did not know it, but it was the business of Mr. Berton to find safe people to lend money to; that is to say, he, of course, knew that money was loaned at banks, but somehow in his dealings he had always felt that in getting a loan he was asking a favor, and so in a sense he was, because he did not have commercial security. He did not know, but Mr. Berton did, that men had to be taken very much into consideration in making loans as well as the security that was offered, and part of the banking business was to judge of the man. His honesty, his ability, and his force of character all come into the matter. The big business man of the future is often the little one of today, and the far-seeing banker is willing to take some chances in helping the development, when he finds what he thinks is the right material. Time and chance might either help or retard, but to get any real growth the material had to be there to start with.

SAMMY'S BUSINESS INCREASES

Gradually Sammy got to be a regular patron of the bank. The amounts were not large, nor the times long, but the business was helped. It used to puzzle him, when he had time to think about it, why it was that with the added volume of business he was still "hard up" for money. The books began to show a profit, but somehow as soon as he got hold of a dollar there was a place waiting where it had to go, and in spite of all his efforts the outstanding amount kept increasing.

He could see that his range was getting larger. The addition of small tools and of stock had put him in better shape to handle work promptly, but the amount left for himself and the Mrs. did not seem to increase much if at all; still he had to have these things if he was to do work. He didn't see any way out of that. To do more work he had to have more tools and material, and to be able to get more tools and material he had to do more work. He was much like the Western farmer who grew corn to feed hogs to sell that he might buy land, and used the land to raise corn to feed hogs to buy land to raise corn to feed hogs, etc. The acreage grew, and the amount of corn grew, and the number of the pigs grew. Likely the variety and frequency of his troubles grew. Whether his joys kept pace with them is another question.

W. OSBORNE.

Many German Farmers are Distilling Alcohol—How the Government Inspects all the Little Stills without Great Expense

Representative E. J. Hill, of Connecticut, who assisted the Commissioner of Internal Revenue to formulate the rules under which the free-alcohol law went into effect on October, spent most of the summer in Europe with Commissioner Yerkes in investigations on this subject. Mr. Hill states that Germany was the country in which the most progress was found to have been made in the direction of applying denatured alcohol for the development of industrial purposes. There are 70,000 farm distilleries in Germany, many of them being very small, and Mr. Hill was asked how the German Government could afford to furnish an inspector to each of these distilleries. He replied:

"There is no difficulty in that respect. The stills have to be made in a certain way, which includes a tank that can be locked with a Government lock and sealed with a Government seal. The small farm distilleries do not operate all the year round. They operate in the winter when the farmer has leisure to do something other than straight farm work. The farmer has to give the Government 30 days' notice as to the time he wants to begin to operate his still. Some time during the 30 days an inspector comes along and looks the still over to see that it is clean, etc., and then he locks and seals the tank, after which the still is ready for the farmer.

"He may go ahead and distil until the tank is full. Then he informs the person who is to buy the alcohol from him, after which he notifies the Government, and an inspector comes and removes the seal, measures the contents of the tank and collects the revenue. If the farmer wants to denature the alcohol on the spot he can do so in the presence of an inspector, when the amount of the tax will be returned to him. But generally the farmers sell through the great central selling agencies, which denature at a central point and in large quantities, and collect the rebate from the Government in considerable sums. Thus the Government agents are not required to spend any appreciable time on any one farm, and one inspector can cover a large territory. Meanwhile the central selling agency pays the farmer on the basis of beverage alcohol and rebates for all that is denatured. It is a good system and not very expensive to the Government."—*Amateur Work.*

The Railroads Making a Lot of Money off the Government

Frank Parsons, in the *Medical World*, presents some figures which are very instructive when considered in connection with the matter of second-class postage rates, upon which we had something to say at page 714, Vol. 29, Part 2. Mr. Parsons states that the railroads were paid last year for carrying the mails $39,384,916, plus $5,509,044 for rentals of postal cars, making a total of about $45,000,000. Prof. H. C. Adams, the railway expert for the United States Interstate Commerce Commission, has shown that the railroad receipts for 100 pounds of freight from New York to Chicago would average 75 cents, for express $1.25 and for mail $3.56; for New York to San Francisco the amounts would be $3 for freight, $6.75 for express and $13.28 for mail per hundred pounds. Many other figures are given, and as a result it appears that the railroads receive on the average for express 50 to 100 per cent. more than for first-class freight, and for mail 100 to 300 per cent. more than for express. The express companies carry magazines and newspapers 500 miles and more at a cent a pound, and the railroads get less than one-half a cent a pound, two cents a ton-mile, or less than one-sixth of the lowest estimate of the average mail rate.

The express companies do not pay rentals for use of express cars. The Government does not pay for the use of postal apartments. It does not then seem reasonable that it should pay rental for postal cars; so that right there is over five and a half million dollars' expenditure for which there does not seem to be any sufficient reason. Furthermore, the remaining $39,000,000 is paid on the basis of a rate two or three times as great as that received by the railroads for the carriage of express.

Professor Adams estimates that the railroads receive for carrying the mails 12.56 cents per ton-mile; for carrying express generally they get from three to six cents per ton-mile; for carrying excess baggage, five to six cents per ton-mile; for commutation passengers, six cents per ton-mile; for carrying ordinary freight in L. C. L., two cents; and for carrying the average of all freight, 0.78 cent per ton-mile. The mail is a sure, steady traffic, homogeneous, easily handled and does not require such expense as does baggage for storage, loading and unloading, etc., there being practically no cost but the cost of haulage. In view of such figures as these it would appear that Uncle Sam should have no doubt as to the location of the hole in his postal pocket.

The new police headquarters building in New York City is to have a wireless police telegraph station on the dome.

THE SHAPE AND DUTY OF ROUGHING TOOLS—II*

BY FRED. W. TAYLOR

ON THE SHAPE OF TOOLS AS AFFECTED BY GRINDING AND FORGING

The following are the important conclusions arrived at upon this subject:

(A) The shapes into which tools are dressed and the ordinary methods of dressing them are highly uneconomical, mainly because they can be ground only a few times before requiring re-dressing.

(B) The tool steel from which the tool is to be forged should be one and one-half times as deep as it is wide.

(C) To avoid the tendency of the tool to upset in the tool post under pressure of the cut, the cutting edge and the nose of the tool should be set well over to one side of the tool.

(D) Tool builders should design lathes, boring mills, etc., with their tool posts set down lower than is customary below the center of the work.

(E) In choosing the shape for dressing a tool, that shape should be given the preference in which the largest amount of work can be done for the smallest combined cost of forging and grinding.

(F) Forging is much more expensive than grinding, therefore the tool should be designed so that it can be ground:

a the greatest number of times with a single dressing; and

b with the smallest cost each time it is ground.

(G) Best method of dressing a tool is to turn its end up high above the body of the tool. Tools can be entirely dressed by this means in two heats.

ON GRINDING TOOLS

The following are the important conclusions arrived at with reference to grinding tools:

(A) More tools are ruined in every machine shop *through overheating in grinding* than from any other cause.

(B) The most important consideration is how to grind tools rapidly without overheating them.

(C) To avoid overheating, a stream of water amounting to five gallons per minute should be thrown, preferably at a slow velocity, directly on the nose of the tool where it is in contact with the emery wheel.

(D) To avoid overheating where tools are ground by hand or with an automatic tool grinder, the surface of the tool should never be allowed to fit closely against the surface of the grindstone. To prevent this, tools should be constantly moved or wabbled about during the operation of grinding.

(E) To lessen the danger of overheating on the emery wheel and to promote rapid grinding, tools should be dressed so as to leave the smith shop with a clearance angle of about 20 degrees, while 6 degrees only is needed for cutting.

(F) Flat surfaces upon tools tend far more than curved surfaces to heat tools in grinding.

(G) Tools with keen lip angles (i.e., steep side slopes) are much more expensive to grind than blunt lip angles.

(H) It is economical to use an automatic tool-grinding machine even in a small shop.

(J) There is little economy in an automatic grinder for any shop unless standard shapes have been adopted for tools, and a large supply of tools is kept always on hand in a first-class tool room so that tools of exactly the same shape can be ground in quite large batches or lots.

(K) Corundum wheels made of a mixture of grit size No. 24 and size No. 30 are the most satisfactory for grinding ordinary shop tools.

(L) In grinding flat surfaces skilful hand grinders invariably keep the tool wabbling about on the face of the grindstone in order to avoid heating.

IMPORTANCE OF LOWERING TOOL SUPPORTS IN DESIGNING MACHINE TOOLS

We attach so much importance to raising the nose of the tool above its top surface and at the same time having the section of the body of the tool deeper than its width, that we would especially call the attention of machine-tool builders to the desirability of designing their tool supports in lathes, boring mills, etc., farther below the centers than is customary. When preparing for the best shop standards in reorganizing the management of machine shops, it has become our custom to systematically go over all of the machine tools and lower the tool rests to as great an extent as is practicable. Fortunately this in many cases entails but a small expense. However, in other cases it has been found desirable and economical to re-design the cross slides of many lathes so as to accomplish this object.

TOOLS SHOULD BE DESIGNED SO THAT LARGEST AMOUNT OF WORK CAN BE DONE FOR SMALLEST COMBINED COST OF FORGING AND GRINDING

In adopting the general shape or conformation of a tool (we do not here refer to the curve of the cutting edge), the most important consideration is that of such a shape with which the largest amount of work can be done for the smallest *combined cost of forging or dressing and grinding*, and the dressing is much the more expensive of these two operations. It is, therefore, of paramount importance to so design the tool that it can be ground:

a the greatest number of times with a single dressing;

b with the smallest cost each time it is ground.

Modern high-speed tools when run at economical speeds are injured much more upon the lip surface than upon the clearance flank. Therefore, at each grinding a larger amount of metal must be ground away from the lip surface than from the clearance flank; and yet in many cases the clearance flank will be more or less injured (rubbed or scraped away) below the cutting edge, and it therefore becomes necessary, for maximum economy, in practical use, to grind roughing tools both upon their lip and their clearance surfaces.

In many shops the practice still prevails of merely cutting a piece of the proper length from a bar of steel and grinding the curve or outline of the cutting edge at the same level as the top of the tool, as shown in Figs. 10 and 11. This entails the minimum cost for dressing, but makes the grinding very expensive, since the lip surface must be ground down into the solid bar of steel, thus bringing the corner of the grindstone or emery wheel at once into action and keeping it continually at work. This quickly rounds over the corner of the stone, and necessitates its frequent truing up, thus increasing the cost of grinding both owing to the waste of the stone and the time required to keep it in order; and it also leaves the face of the grindstone high in the center most of the time, and unfit for accurate work.

As far as possible, then, the shape of standard cutting tools should be such as to call for little or no grinding in which the corner of the emery wheel does much work. With the type of tool illustrated in Fig. 10, also, comparatively few grindings will make a deep depression in the body of the tool, as shown in Fig. 12, and this depression will of course be greater the steeper the back slope of the lip surface of the tool.

To avoid these difficulties, perhaps the larger number of well managed machine shops in this country have adopted a type for dressing their tools in which the front of the tool is forged slightly above the level of the tool, as shown in Figs. 11 and 12.

The objection to both of these types is that the tools require re-dressing after being ground a comparatively small number of times, and that when re-dressed in many cases the whole nose of the tool is cut off and thrown away. (This waste of metal, however, is of much less consequence than the frequency of dressing.)

It will also be observed that with the first of these types of tool dressing the

*Extract from the presidential address before the American Society of Mechanical Engineers.

tendency is to make the nose of the tool too thin, that is, having too small a radius of curvature, and thus to furnish a tool which must be run at too slow cutting speeds. It will be noted that both of these types of tool dressing call for at least one heating of the tool and that in most cases the tool is actually heated twice.

THE BEST METHOD OF FORGING A TOOL IS TO BEND OR TURN UP ITS END

Undoubtedly one of the most economical shapes for tools, when both dressing and grinding costs are considered, is that shown in our standard tool, Fig. 4.

In the 1½-inch tool, for instance, the cutting edge is 1 3/16 inches above the top of the body, and if we assume that 1/32 of an inch of metal ground off from the hight of the tool will be sufficient to sharpen the cutting edge on an average, it is evident that a tool of this shape can be ground 24 times before the corner of the emery wheel begins to cut into the body of the tool. If after this we continue to grind the tool, there will still remain as many grindings on this tool as upon tool, Fig. 12, before the wheel shall have ground down into the body of the tool for a sufficient depth to weaken it. Thus it is clear that our standard tool has a shape which permits it to be reground from three to five times as many times as the ordinary shape shown in Fig. 12.

IT IS A BAD PRACTICE TO NICK THE BAR OF TOOL STEEL AND BREAK IT OFF COLD

The practice of nicking the bar of tool steel with a cold chisel at points corresponding to the proper length of the tool, and then breaking it where nicked by a blow of the sledge on the anvil, is on the whole unwise, as not unfrequently almost invisible cracks are started which may only fully develop after the tool is in use. In cutting to length with a "hot chisel" a low heat is sufficient and the same heat can be used for stamping the rear end of the tool for identification.

IMPORTANCE OF USING A HEAVY STREAM OF WATER DIRECTLY ON NOSE OF TOOL IN GRINDING TOOLS

Attention has been called to the great injury which is constantly being done to the modern high-speed tools by heating the cutting edge too hot on the grindstone. It becomes of the first importance in grinding, whether an automatic tool grinder is used or whether tools are ground by hand, always to throw a heavy stream of water upon the nose directly at the spot where the emery wheel or grindstone is doing its work. The practice of pouring water upon the emery wheel above the tool and allowing the stone to carry the water along with it is to be avoided, as this method provides entirely too small an amount of water to properly cool the tool. We have found by experiment that it requires a stream of water of not less than five gallons per minute, thrown directly upon the cutting edge of the tool, to prevent its being overheated on the grindstone. The water should be thrown in a large stream with slow velocity to avoid splashing.

The necessity for not overheating the tool in grinding also modifies the shape for forging our standard tool. It will be noted that the noses of our standard tools as they come from the smith shop have clearance angles of 20 degrees, whereas a clearance angle of 6 degrees is ample for shop use. In other words, the noses of our standard tools lean far forward out of the perpendicular. The object of this is to make the distance beneath the cutting edge, which must be ground off of the flank each time the tool is sharpened, as short as possible. In this way a smaller pressure between the tool and the grindstone is called for, the tool is ground in a much shorter time, less heat is generated by the grindstone, and there is less danger of injuring the tool from overheating.

The nose when cut off by the blacksmith has also a much more acute lip angle than is actually needed in the machine shop for cutting. This acute angle is given the tool for the same reason as was the extra clearance angle, namely, to diminish the extent of the surface which must be ground from the lip surface of the tool.

In Fig. 4 it will be noted that broken lines above and beyond the upper part of the nose of the tool indicate the shape to which the tool is forged, while the solid, heavy lines indicate the shape to which the tool is ground at its first grinding.

Our reason for leaving so much metal in the forged tool to be ground off is that sometimes in giving the tool the high heat, owing to too slow a fire being used, the metal close to the surface of the nose of the tool is somewhat injured, and by grinding off this exposed point of the tool at its first grinding, a tool which runs at once at its highest cutting speed can be obtained.

POWER REQUIRED TO FEED THE TOOL.

By far the most important conclusion arrived at by us in the field of "Pressure of the Chip on the Tool" is that the gearing designed in lathes, boring mills, etc., for feeding the tool should be sufficiently strong to deliver at the nose of the tool *a feeding pressure equal to the entire driving pressure of the chip upon the lip surface of the tool.* This fact was developed by us in an experiment made in the year 1883 in the works of the Midvale Steel Company, and had such an important bearing upon the cost of turning out the product in the machine shop of those works that the results of this one simple investigation more than paid for all the experiments in the entire field of cutting metals undertaken in the Midvale Steel Works.

The use just once of a scandalously dull tool in a machine would of course suffice to smash the feed gearing. An experiment made with a tool of this kind demonstrated the fact that to insure against breakage sufficient strength was called for in the feed gears to deliver at the nose of the tool a pressure equal to the total driving pressure of the chip upon the tool.

EFFECT UPON THE CUTTING SPEED OF POURING A HEAVY STREAM OF WATER UPON THE CUTTING EDGE OF THE TOOL

Cooling the nose of a tool by throwing a heavy stream of water or other fluid directly upon the chip at the point where it is being removed by the tool from the steel forging enables the operator to increase his cutting speed about 40 per cent. The economy realized through this simple expedient is so large that it is a matter of the greatest surprise that experimenters on the art of cutting metals have entirely overlooked this source of gain. So far as the writer is aware, no experiments upon this subject have as yet been published. In spite of the fact that (as a result of our experiments) the whole machine shop of the Midvale Steel Company was especially designed as long ago as 1893 for the use of a heavy stream of water (super-saturated with soda to prevent rusting) upon each cutting tool, until very recently practically no other shops in this country have been similarly equipped.

The following are the important conclusions arrived at as to the effect on the cutting speed of cooling the tool with a heavy stream of water:

With high-speed tools a gain of 40 per cent. can be made in cutting steel or wrought iron by throwing in the most advantageous manner a heavy stream of water upon the tool.

A heavy stream of water (3 gallons per minute) for a 2x2½-inch tool and a smaller quantity as the tool grows smaller, should be thrown directly upon the chip at the point where it is being removed from the forging by the tool. Water thrown upon any other part of the tool or the forging is much less efficient.

The gain in cutting speed through the use of water on the tool is practically the same for all qualities of steel from the softest to the hardest.

The percentage of gain in cutting speed through the use of water on the tool is practically the same whether thin or thick chips are being removed by the tool.

With modern high-speed tools a gain of 16 per cent. can be made by throwing a heavy stream of water on the chip in cutting *cast iron.*

To get the proper economy from the use of water in cooling the tool, the machine shop should be especially designed and the machine tools especially set with a view to the proper and convenient use of water.

In cutting steel, the better the quality of tool steel, the greater the percentage of gain through the use of a heavy stream of water thrown directly upon the chip at the point where it is being removed from the forging by the tool. The gain for the different types of tools in cutting steel is:

a Modern high-speed tools 40 per cent;

b Old style self-hardening tools 33 per cent;

c Carbon-tempered tools 25 per cent.

THE PORTION OF THE TOOL ON WHICH THE WATER JET SHOULD BE THROWN

A series of experiments has demonstrated that water thrown directly upon the chip at the point where it is being removed from the forging by the tool will give higher cutting speeds than if used in any other way.

As another illustration of the small value to be attached to theories which have not been proved, we would cite the following: After deciding to try experiments upon the cooling effect of water when used upon a tool, it was our judgment that if a stream of water were thrown upward between the clearance flank of the tool and the forging itself in this way the water would reach almost to the cutting edge of the tool at the part where it most requires cooling, and that, by this means, the maximum cooling effect of the water would be realized. We, therefore, arranged for a strong water jet to be thrown, as shown in Fig. 13, between the clearance flank of the tool and the flank of the forging, and made a series of experiments to determine the cooling effect of water with various feeds and depths of cut. So confident were we of the truth of this theory that we did not deem it worth while to experiment with throwing streams of water in any other way, until months afterward, when upon throwing a stream of water upon the chip directly at the point where it is being removed from the forging by the tool, we found a material increase in the cutting speed, and thus our first experiments were rendered valueless.

Practically, great difficulty will be found in getting machinists in the average shop to direct the stream of water on to the chip in the proper way as indicated in Fig. 14, because when a sufficiently heavy stream of water is thrown upon the work at this point it splashes much more than when thrown upon the forging just above the chip; and the machinists prefer slower cutting speeds and less splash.

ARRANGEMENT FOR SUPPLYING WATER TO THE TOOL

It has been customary for many years to use under certain circumstances a small trickling stream of water upon cutting tools (mostly on finishing tools, and with the object of giving the work what is called a "water finish"). For this purpose a small water can is generally mounted upon the saddle of the machine above the tool, and refilled from time to time by the machinist. Such streams of water, however, have little or no effect in increasing the cutting speed because they are too small in volume to appreciably cool the nose of the tool.

The most satisfactory results are obtained from a stream of water falling at rather slow velocity, but with large volume, at the proper point upon the tool; since a stream of this sort covers a larger area of the tool and is much freer from splash.

This water supply should be delivered through pipes fitted up with universal friction joints, so that the apparatus can be quickly adjusted to deliver the water at any desired point (the pipe being supported by a rigid bracket attached to the saddle of the lathe, preferably on the back side so as to be out of the way). In the case of short lathe beds the water supply can be delivered from overhead through a rubber hose, and in the case of long lathe beds through telescoping pipes attached to the saddle (smooth drawn brass pipes telescoping inside of ordinary wrought-iron pipes, with suitable stuffing boxes being used).

For economy, the same water should be used over and over again, and it should be supersaturated with soda to prevent the machines from rusting. Wrought-iron pipes about 1¼ inches diameter should lead the water from beneath the machine below the floor to the main soda-water drains at the side of the shop. These drains are made of pipe from 3½ to 5 inches in diameter, with a chain extending through them from one end to the other, the chain being twice as long as the drain through which it extends. In case of sediment forming in this pipe or in case of chips passing by the double sets of screens and double settling pots which should be supplied at each machine, the drain can be quickly cleaned by pulling the chain backward and forward through it once or twice.

The soda water is returned through this system of underground piping to a large central underground tank, from which it is pumped through a small, positive, continuously running pump, driven by the main line of shafting, into an overhead tank with overflow which keeps the overhead soda-water supply mains continually filled and under a uniform head. If the shop is constructed with a concrete floor, a catch basin for the water can be molded in the concrete directly beneath each machine. Otherwise, each machine should be set in a large wrought-iron pan or shallow receptacle which catches the soda water and the chips. In both cases, however, two successive settling pots—independently screened so as to prevent the chips, as far as possible, from getting into the return main—are required beneath each machine.

The ends of the 1¼-inch wrought-iron pipes which lead the water from the machines to a large drain at the side of the shop should be curved up with a sweeping curve so that their outer ends come close to the top of the floor of the shop. The sediment and chips must be

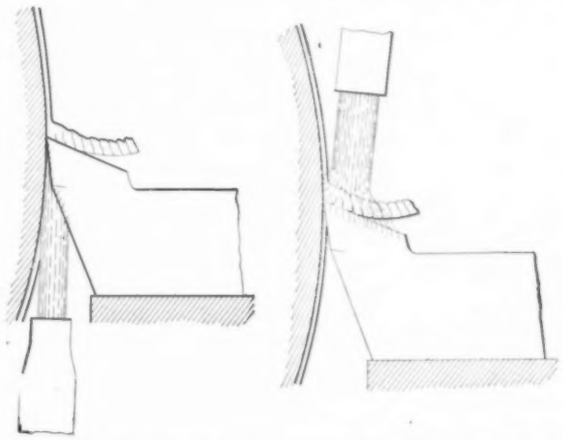


FIG. 13. WRONG WAY OF THROWING WATER ON TOOLS

FIG. 14. PROPER WAY OF THROWING WATER ON TOOLS

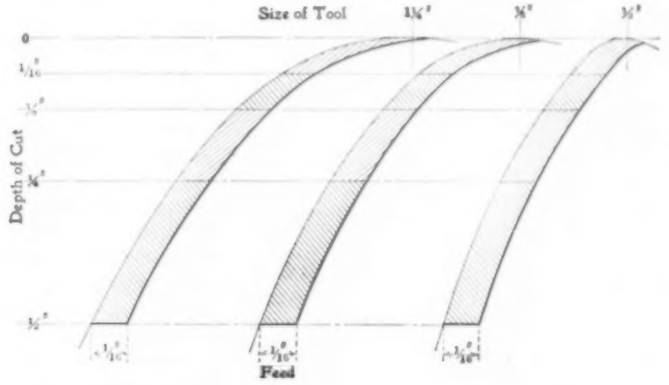


FIG. 15. ENLARGED SECTIONS OF CHIPS CUT BY STANDARD ROUND NOSE TOOLS, ALL TAKING A FEED OF 1/16 INCH

cleaned from these pipes from time to time by means of a long round steel rod from ⅜ to ½ inch in diameter, which after removing the plug at the outer end of the drain pipes, is shoved through the pipe. Apparatus of this type has been in successful use for about 23 years with no trouble from clogging.

16 PER CENT. GAIN IN CUTTING SPEED FROM THROWING A HEAVY STREAM OF WATER UPON THE TOOL IN CUTTING CAST IRON

In 1906, after the writing of this paper was well under way, it occurred to us that we had accepted as true without verification through accurate experiments the fact that water could not be used in cutting cast iron. This is another of the many instances in which an absolutely erroneous opinion prevails throughout all of our machine shops without any foundation in fact. It is likely, however, that this opinion has become so firmly rooted in the minds of all mechanics and foremen from the fact that a water finish cannot be made on cast iron, while it is in many cases most desirable for steel.

To determine the effect of a heavy stream of water in cooling a tool cutting cast iron, experiments (similar to those described above) were made by us during the summer and fall of 1906 on a test piece consisting of exceedingly hard cast iron with cutting tools of three different chemical compositions.

The following table represents the average gain made by these tools when they were run with a heavy stream of water as compared with running under exactly the same conditions dry. Depth of cut 3/16 inch, feed 1/16 inch, standard 20-minute cut; tools used, our standard ⅞-inch, Fig. 4.

Cutting speed without water	47 ft.
Cutting speed with heavy stream of water	54 ft. 7 in.
Gain through use of water	16%

THE EFFECT OF VARYING THE FEED AND THE DEPTH OF THE CUT UPON THE CUTTING SPEED

The following are the principal conclusions arrived at on this subject:

(A) With any given depth of cut metal can be removed faster, i.e., more work can be done, by using the combination of a coarse feed with its accompanying slower speed than by using a fine feed with its accompanying higher speed.

For example, by referring to any of the sets of experiments in cutting steel, it will be noted that if with a combination of 3/16-inch depth of cut and 1/64-inch feed, the hardness of the metal were of such a quality, for instance, that just 100 pounds of chips would be cut off in an hour by using the same tool on the same forging at its proper cutting speed corresponding to a feed of ⅛-inch, the metal would then be removed at the rate of 250 pounds per hour. In most cases it is not practicable for the operator to take the coarsest feeds, owing either to the lack of pulling power of the machine or the elasticity of the work. Therefore, the above rule is only of course a broad general statement.

(B) The cutting speed is affected more by the thickness of the shaving than by the depth of the cut. A change in the thickness of the shaving has about three times as much effect on the cutting speed as a similar or proportional change in the depth of the cut has upon the cutting speed. Dividing the thickness of the shaving by 3 increases the cutting speed 1.8 times, while dividing the length that the shaving bears on the cutting edge by 3 increases the cutting speed 1.27 times.

(C) Expressed in mathematical terms, the cutting speed varies with our standard round-nosed tool approximately in inverse proportion to the square root of the thickness of the shaving or of the feed; i.e., S varies with $\sqrt{F}$ approximately.

(D) With the best modern high-speed tools, varying the feed and the depth of the cut causes the cutting speed to vary in practically the same ratio whether soft or hard metals are being cut.

(E) The same general formula expresses the laws for the effect of depth of cut and feed upon the speed, the constants only requiring to be changed.

(F) The same general type of formula expresses the laws governing the effect of the feed and depth of cut upon the cutting speed when using our different sized standard tools.

IMPORTANCE OF THE STUDY OF EFFECT OF FEED AND DEPTH OF CUT UPON CUTTING SPEED AND THE DIFFICULTIES ATTENDING THESE EXPERIMENTS

A study of the effect of the feed and depth of cut upon the cutting speed constitutes in our judgment the most important element in the art of cutting metals. The three questions which must be answered each day in every machine shop by every machinist who is running a metal-cutting machine, such as a lathe, planer, etc., are:

What tool shall I use?
What cutting speed shall I use?
What feed shall I use?

Having already established in a shop standards for the shape and quality of the tools, there remain but two of these question to be answered, namely, as to the cutting speed and the feed. And the decision as to the cutting speed will depend more upon the depth of cut and feed which are chosen than upon any other element.

Experiments upon these two elements can only be undertaken after practically all of the other elements in the art of cutting metals have been standardized. A standard quality of tool steel and its proper heat treatment must have been established. A standard curve for the cutting edge of the tools, with standard lip angles, back slope and side slope, must have been established. The effect of the quality of the metal which is to be cut upon the pressure on the tool and of the pressure on the tool upon the pulling or driving power of the machine must be known before it is possible to decide upon the depth of cut and feed.

The depth of cut and feed, then, are of necessity almost the last elements to be experimented upon, and with the exception of determining the combination of the best tool steel and its proper heat treatment, they constitute the two elements to which we have given the largest amount of time and study. We have undertaken many sets of experiments upon this subject since 1881, when we first began its investigation. The accurate determination of these laws is rendered especially difficult owing to the necessity for making such a large number of experiments in cutting pieces of test metal which are uniform in quality. We have found it difficult to obtain large enough masses of uniform metal to accurately determine these laws, and each improvement in the quality of the tool steel which gives higher cutting speeds calls for larger and larger masses of uniform test metal, thus greatly increasing the difficulty and expense of these experiments.

Moreover, each change in almost any one of our important standards involves in the end a more or less elaborate investigation as to what modification the new standard has made in the effect that a change of feed or depth of cut has upon the cutting speed. Time after time the absolutely necessary changes in standards have forced us to reinvestigate the effect of feed and depth of cut upon the cutting speed; and viewed from the point of expense alone, such an investigation is truly a serious undertaking. It is a matter of doubt to the writer whether with our accumulated experience it would be possible even now for us to make a consistent series of experiments either upon steel or cast iron with these two elements at a smaller cost than $5000.

All of these facts emphasize the desirability for the greatest care and consideration in adopting shop standards, and indicate the importance of not changing shop standards when once adopted except from imperative necessity.

The accompanying tables are practical working tables which will be found useful by machine-shop foremen and machinists as a general guide to determining what cutting speed to use under several of the usual or typical conditions met with in ordinary machine-shop practice. The cutting speeds given in these tables are based upon the use of our standard tools. In making these tables we also assumed the use of the best quality of high-speed tool, treated in the

best manner. The tables were also based upon cutting three different qualities of steel.

The tables made out for cutting cast iron are based upon three qualities of cast iron which we have found representative of hard, medium and soft cast iron as ordinarily found in the average machine shop in this country. In each shop, however, accurate experiments should be made to determine the average cutting speeds of the cast iron actually used.

It should be noted that a change in feed produces a change in the thickness of the chip which is cut by the tool, and that it is the actual thickness of the chip as it crosses the line of the cutting edge of the tool which causes or produces the change in cutting speed. The thinner the chip or shaving the higher the cutting speed, and the thicker the chip the slower the cutting speed.

EFFECT OF LINE OR CURVE OF THE CUTTING EDGE ON THE CUTTING SPEED.

We have pointed out the effect which the curve or outline of the cutting edge has upon the cutting speed, and we have endeavored to make it clear that the curve of the cutting edge of the tool affects the cutting speed chiefly because of the variation in the thickness of the chip or shaving which it produces. In general, the larger the radius of curvature of the cutting edge and the more nearly the general curve of the cutting edge lies parallel in a general way to the center line, or axis, of the work which is being cut, the thinner becomes the shaving and the higher the cutting speed.

We have also endeavored to make it clear that a cutting edge, with a curved outline, invariably produces a shaving which varies in its thickness at all points.

In Figs. 7 and 15 are given (on enlarged scales) views of the actual sections of the chip as removed by tools having different shaped cutting edges. By referring particularly to Fig. 15 in the case, for instance, of a cut ⅛ inch in depth, the large difference in the shaving which is produced in one case by our ½-inch standard tool, and in the other case by our 1¼-inch tool, will be clearly seen.

LARGE CURVE FOR CUTTING EDGE. THINNING DOWN THE SHAVING PRODUCES FASTER CUTTING SPEED

By referring to our practical tables for cutting steel, using ⅛ inch depth of cut and 1/16-inch feed, in the one case, with our standard 1¼-inch tool, and in the other case, with our standard ½-inch tool, the difference in the cutting speed produced by the thinning down of the shaving, owing to the change in the curve, will be observed. The thinner shaving accompanying the 1¼-inch tool in cutting medium steel, for instance, gives a cutting speed of 112 feet per minute as against a cutting speed of 81 feet for the thicker shaving of the ½-inch tool.

It is obvious that some general law must exist for determining the relative cutting speed of tools having different curves for the outline of their cutting edges and that we should be able to determine this law by plotting on an enlarged scale the exact shape of the two sections of shavings which are being removed, as has been done in Figs. 7 and 15, and then comparing these shapes with their corresponding cutting speeds. We have once or twice started on this line of investigation, but have never had the time, or as yet sufficient data, to enable us to determine accurately this law, and this would seem to form an important subject for future investigation.

Legal Notes

BY E. P. BUFFET

LIABILITY OF AGENT ACTING FOR UNDISCLOSED PRINCIPAL

At page 817, Vol. 29, Part 1, a correspondent, Entropy, asks "whether a dealer who appears to act for himself can be called upon to stand on his own bottom. If he was acting for the manufacturer and selling on commission so that the real trade was between manufacturer and customer," says Entropy, "then I could see it, but where a man represents that he is buying again to sell at his own price I fail to see why the manufacturer should have to go beyond him in his dealings."

This question is answered by the cold, hard principles of law long before we reach its finer ethical considerations. Someone has sagely remarked that the function of lawyers is to show us how we can break all the commandments without going to jail. Therefore the fact that the law allows us to do a thing is no reason to suppose that it is right; while, on the other hand, if in a matter affecting honesty we find a legal prohibition, we may almost invariably assume that the act forbidden is very unethical indeed.

It is an elementary legal proposition that an agent is personally responsible where at the time of making the contract he does not disclose the fact of his agency, but treats with the other party as being himself the principal; for, in such a case, it follows irresistibly, that credit is given to him on account of the contract. Thus, if a factor, or broker, or other agent, buys goods in his own name for his principal, he will be responsible to the seller therefor if his agency is not disclosed, although if the real principal be afterward discovered he may, under some circumstances at least, be held.

It has even been said that the liability of the agent applies to cases where he acts in the character of an agent, but the name of his principal is not disclosed; for until such disclosure, it is impossible to suppose that the other party is willing to enter into a contract, exonerating the agent and trusting to an unknown principal, who may be insolvent or incapable of binding himself. We see, therefore, that if this be true the law of agency goes even farther than Entropy suggests that the ethics ought to go. But this does not seem to be the prevailing modern rule of law. An agent who makes it sufficiently clear that he is acting only in that capacity, although for an unnamed principal, would probably be exempt from personal liability. But it depends on the construction of the contract, and the mere fact of signing as "John Smith, agent" is not regarded as exempting him from personal accountability. Extraneous knowledge of the name of a principal by a party dealing with an agent may have the same effect as if the agent disclosed it, unless the agent purposely represents himself to be the principal.

Under the conditions cited by Entropy the principal's name was known but his function as a principal was not, so the case seems to be one of undisclosed principal.

CONDITIONAL SALE OF CASH REGISTER

In a case before the Nebraska Supreme Court, evidence was offered, in part tending to show the following circumstances: A cash-register company had shipped to a certain business man in the city of Alliance, Neb., a cash register on which he was to pay $40 cash and $25 monthly for the balance; the deferred payments to be secured by a contract to be executed by him, whereby the title to the register was to remain in the company until all payments had been made. The register was to be delivered to the buyer by an express company upon his paying the $40 and signing the contract and notes. This arrangement was carried out, except that his signature to the contract was in some way overlooked. Upon discovering that fact the cash-register company insisted upon his signature, but without returning, or offering to return, the cash payment or the notes for the deferred payments. The court holds, therefore, that the company is not in a position to treat the sale as rescinded. By retaining the cash consideration and notes they must be held to have ratified the sale. That being so, the most favorable view that can be taken of the case is that the sale is conditional. This alleged condition, whereby the title remained in the cash-register company, is, however, void as to a party who has in good faith purchased the register, along with other business outfit, from the buyer, and who has no notice, actual or constructive, of the condition. Such is true under a Nebraska statute, but in view of the conflicting laws of different States as to the rights of third parties in conditional sales, we must not assume the decision to be of universal application.

109 N. W. Rep., 738.

CORRESPONDENCE

Discussing Phases of Machine Design and Construction

A Variable-speed Device

Some years ago, at the experimental laboratory of Marvin & Casler, at Canastota, N. Y., it was found desirable to have some means of readily changing the speed of driving various experimental machines through wide ranges. To accomplish this end the device of which the following is a description was designed by Mr. Casler. The device as used in connection with a ½-horse-power motor is shown in Fig. 1. The construction is shown by the sketch.

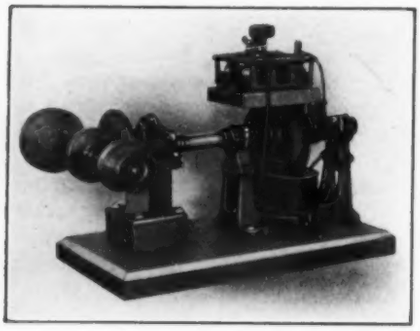


FIG. 1. A VARIABLE-SPEED DEVICE

Referring to Fig. 2, it will be seen that it consists of a leather-covered friction disk *A*, mounted on the driving shaft *B*, which is carried by the cast-iron quill *C*. Between the hub of the friction disk and the end of the quill is a fiber washer *D* to take the thrust. A key prevents the quill from turning. To throw the disk into or out of contact with the friction wheel *E* a worm is provided, meshing into rack teeth cut in the quill and actuated by the hand lever *G*, which is limited in its motion by the stop-pin *H* striking lugs provided in the frame casting. To provide for wear, a series of holes is drilled through the worm, as shown by Fig. 3, so that the stop pin may be inserted at various points, being held by the set screw shown in lever *G*, Fig. 4.

It will be understood that the amount of longitudinal movement required of the shaft carrying the friction disk is very slight. The cast-iron friction wheel *E* is a sliding fit on the shaft *I* and is secured to it by a set screw *J* abutting against a key. To change the speed of the driven shaft *I* it is only necessary to throw over the lever *G*, which will release the friction disk, when, by loosening the set screw *J*, the friction wheel may be readily moved along the shaft *I* in either direction, thereby increasing or dimininshing the speed as required. Should it be found desirable to change the direction of rotation of the shaft *I*, the wheel may be moved to the other side of the center of the disk, where it operates equally well.

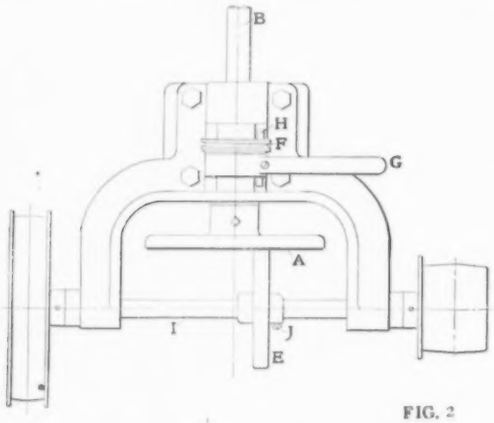
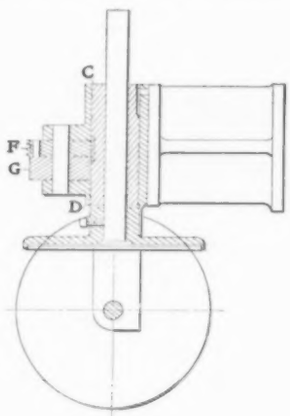


FIG. 2



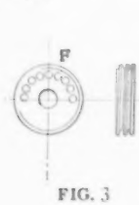


FIG. 3

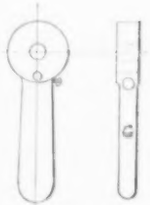


FIG. 4

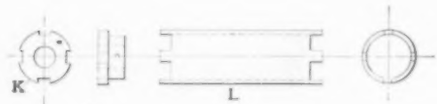


FIG. 5

A SPEED-VARYING DEVICE

As shown in the half-tone, the device is mounted upon a plank with the motor. This was to facilitate moving the entire rig, but it was found necessary to provide a connection that would have a limited amount of flexibility between the motor shaft and the speed device, so the construction shown by Fig. 5 was designed and used successfully. Two steel collars *K* were made and one pinned to each shaft. A piece of pipe *L* was smoothed up and notched, as shown, to fit the notches in the collars, a little end play being allowed. For the amount of power transmitted this worked well.

After using this device, as above described, another one was made to place on the bench, shaft *B* being driven by belt and pulley from an overhead shaft. Instead of the pulleys on the ends of shaft *I*, tapers were turned and drill chucks fitted. This proved a great convenience to the assemblers for filing pins, etc. The disk in this case was kept running constantly, and when power was required, the lever was conveniently thrown over. The principles employed in the foregoing device are of course old, but the application has occasioned favorable comment.

H. D. POMEROY.

Internal Wet Grinding

Why do the manufacturers of wet grinding machinery claim that it is not practical to use water on internal work? Is it because they do not want to provide for it? I know of at least two of the largest manufacturers of this class of machinery who say that you cannot use water satisfactorily for this class of work, but I have never heard a valid reason for this statement.

I know of several cases where water is used, and at least to the user it is a very satisfactory arrangement, though I have personally never seen the work referred to; but I have recently seen some experiments along this line, and they were wholly successful, to the best of my knowledge.

Why do we use water for external work? Because it keeps the work cool so we can caliper at a normal temperature, and not have to caliper and then guess; and because a properly directed stream of water keeps the wheel in better condition

and enables the operator to turn out more work. Is there any reason why these conditions should not hold for internal work? Isn't it just as necessary to have normal conditions for calipering. Of course the results of carelessness in noting the condition of the work are not so serious in internal as in external work. I presume we have all had the experience of grinding a shaft to a nice fit in a gage on a cutter grinder, and then having to make another because it fell through the gage about five minutes afterward; while on internal work if it is so warm as to affect the calipering we can usually take a little more out; but did you ever grind a bushing to a nice, neat fit on a gage, and leave the gage in it a minute, and get a shrink fit?

In regard to the condition of the wheel it seems as though, if water improved the condition of the wheel in external work, it would in internal; and there is the further advantage which we do not have in external work, that water will keep the outer end of the internal fixture cool, and everyone who has used these fixtures knows what a desirable feature this is. The internal fixture at best is a hard proposition to handle, with its high speed, extended bearing, and necessarily small diameter, and its work cannot be pushed; and anything we can do to improve its working conditions will help out a vexatious problem.

Speaking of internal fixtures, the firm with whom I am employed some time ago made some extended experiments in the use of ball bearings, and at that time sent out two sets of fixtures, exactly alike in every particular, to two different customers. One cus omer had previously been using our regular fixture; he found the ball-bearing fixtures wholly satisfactory, and has used no other, and cannot be persuaded to try any other; the other customer could not use the ball-bearing fixture. These experiments were not very successful, and the plan was abandoned; but we are s ill sending the ball-bearing fixtures to the one customer.

Returning to the wet internal grinding proposition, it may be that I am the only one who has fancied it, and that my theories on the subject are all wrong. If so, I am still "from Missouri," and I should like to be shown; I should like particularly to hear from Mr. Norton on this subject, for I believe he is on the other side of the question. INVESTIGATOR.

Reboring a Large Sheave

Replying to the inquiry of E. J. Bowers, at page 58, regarding the reboring of the large sheave, I will state that, as the job was done 17 years ago, my recollection of details is very vague and I am not in a position to find out. I should guess that the bore was enlarged ¼ inch diameter. It is hardly probable that the keyway was all cut out. As stated in the article, the feed was governed by the weight on the upper end of the bar, perhaps 1/32 inch per revolution. The shape of the cutter was beveled about 45 degrees and was approximately what any ordinary machinist would make for a similar job.

H. D. POMEROY.

A Riveting Die

The sketches show a riveting device, for riveting ears to buckets, forcing both rivets through the bucket into and through the rivet holes in the ears, and heading both rivets at one stroke of the press.

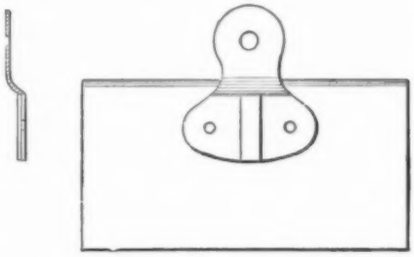


FIG. 1. THE BUCKET AND THE BAIL

This work is usually done by hand and is rather slow work at that, but with the tool described 4000 ears have been riveted to the pails by a boy, in a day's work of ten hours. The ears must be of uniform shape and the holes in the ears must be uniformly spaced. A riveting tool for each size of ears is necessary, as the tool cannot be made adjustable. The results

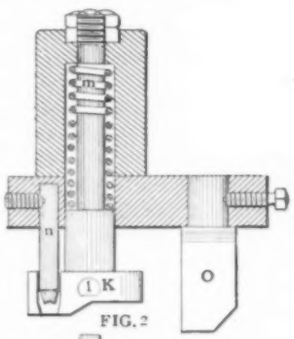


FIG. 2

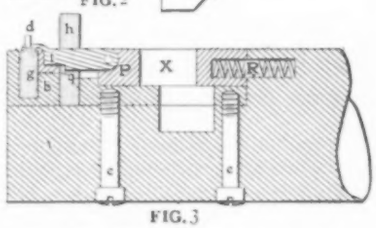


FIG. 3

THE PUNCH AND ANVIL

obtained warrant the installation of such a tool. I have made a set of four tools for one firm, which are in successful operation today. The same principle can be used for other purposes, as I have forced single rivets through two thicknesses of No. 28 gage iron successfully on other work.

DESCRIPTION OF TOOL

Fig. 1 shows an ear and pail ready to be riveted. Fig. 2 shows the punch; Fig. 3 shows a partly sectional side view; Fig. 4 is a sectional end view; and Fig. 5 is the top view of the riveting die with pail and ear in position to be riveted.

The horn *a* carries the die *b* fastened to it by two fillister-head screws *c c*. The two rivets *d d*, Fig. 4, and *d*, Fig. 3, are held by two rivet holders *f f*. The rivet holders are hinged in the rivet-holder

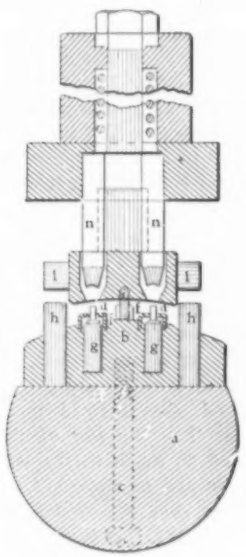


FIG. 4. SECTIONAL END VIEW OF PUNCH AND ANVIL

slide *p*. The heads of the rivets rest on the anvils *g g*, Fig. 4. To rivet the ears to the pail the pail is placed over the rivets with the top edge resting against the two stops *h h*. The ear is then put on top of the pail with the bail hole put over the pin *i*, Fig. 4, so as to hold it in proper position. This done, trip the treadle of the press, and part *k* of the punch, Fig. 4, descends and forces the two rivets through the pail into and through the

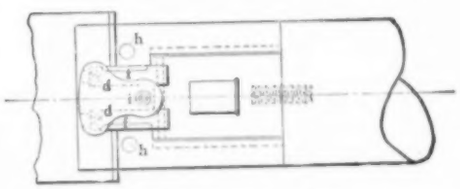


FIG. 5. TOP VIEW OF ANVIL

holes in the ear, by means of the heavy spring *m*, Fig. 2. Part *k* is stopped from pressing on the rivet holders by the bar *l l*, Fig. 4, coming in contact with the stop *h h*. At this moment the wedge-shaped piece *o*, Fig. 2, engages in the hole *x* in the rivet-holder slide *p* and withdraws the rivet holders which drop on their way back at point *q*, Fig. 3, and the riveting punches *n n*, Fig. 4, come down and head the rivets. The punch going up releases the rivet-holder slide, which is carried forward to its original position by the spring *r*. JULIUS F. A. VOGT.

Casting Steam-tight Heads for a Sheet-steel Radiator

Of late your humble servant has been hard at work getting up a new kind of radiator for steam heating. As is frequently the case with inventors, the road proved quite a thorny one; nevertheless, in the end patience won the day.

The body consists of two thin sheet-iron plates of corrugated form, as shown in Fig. 1, with an open space of ⅛ inch between them to allow the free circulation of steam. Of course, our main object in getting up this apparatus was to produce an article at once useful, inexpensive and marketable. In all our experimenting, we kept this end constantly in view. So far as the corrugated iron part was concerned, that could be easily produced, because we had at hand already a machine capable of bending the sheet iron into the required shape. Our next step was to find suitable heads for the corrugated part, but this did not prove quite so easy a task. First, we tried running lead around both top and bottom, and that seemed to work all right. But then the use of this heavy metal added so much to the weight and cost that we had to discard it altogether. Another idea then occurred to us. Why not make cast-iron heads for the ends of the corrugations? With this idea in mind, we started out bravely to experiment along the new line, only to discover soon

FIG. 1

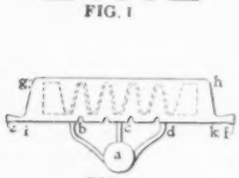


FIG. 2

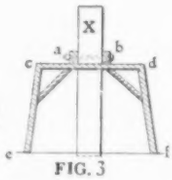


FIG. 3

CASTING STEAM-TIGHT HEADS FOR SHEET-STEEL RADIATORS

that our pathway was by no means strewn with roses. Trial after trial proved unsatisfactory. Without the least difficulty the melted metal would flow around the sheet iron and the joints appeared good and tight. So far as eye could see, there seemed to be no trouble on that score; and yet when the radiator was subjected to a fair test, the steam was sure to leak out at some point or other. Time and again this was our sad experience. Nothing daunted by repeated failures, we still kept on experimenting until at last the difficult problem was mastered to our entire satisfaction. A result was attained that gives an absolutely steam-tight radiator. So after all our headaches and heartaches, we feel amply repaid for our dogged persistency.

Being somewhat out of the ordinary line, this process should have a peculiar interest for iron-workers of all kinds, especially foundry men. Briefly told, it is as follows: By means of a wooden pattern an open sand mold, ¾ inch deep, is made like the one shown in Fig. 2. Over this is suspended the corrugated part, so placed as to allow one end to drop ⅜ inch into the mold. The corrugation, let it be added, is held rigidly in place by means of a long, wooden clamp, bolted together at each end and resting upon two benches or supports.

When everything is in readiness the melted iron is poured into the sand at *a*, and through the three grates *b c d* runs into the mold proper. The pouring is kept on until the metal flows out at *e* and *f*, where holes in the sand receive the overflow. The object of all this process is to obtain a uniform heat throughout all parts of the mold, and for a time sufficiently long to secure a thorough welding of the two metals together. The next day the other end is subjected to a similar treatment, with, of course, the same result—a perfectly tight union or welding of the hot and cold metals. In this completed form the radiators have been put to severe tests, which in every instance have proved satisfactory. The process, we feel assured, has passed out of the experimental stage and may now be regarded as a demonstrated fact. So far as weight and expense go, the result is all that could be desired. Above all, we feel that a problem difficult of solution has been mastered; namely, the securing, by a process of molding, of a steam-tight joint. As every experienced iron-worker knows, steam is of such a penetrating nature that it will leak out of the smallest imaginable opening. To prevent absolutely the possibility of such a leakage by a process of molding is therefore an achievement of no mean order.

That portion of the mold indicated *a*, *b*, *c*, *d*, also *e* and *f*, are mere gates to be lopped off in the cold iron, leaving *g h k i* as the real shape of the heads. The dotted lines in Fig. 2 are designed to indicate the position of the corrugated sheet iron in the head-piece. In Fig. 3, *a b* is a clamp holding the radiator. The clamp *a b* rests on the supports *c d e f*.

HOMO.

What Has the Shrink Rule to do with the Size of Castings?

It seems to me that the universal contraction or shrink rule described at page 10 is of little practical use, though the principle is very good, no doubt, particularly in its application to compound shrinkages. But why didn't Mr. Barrows design it to apply to the conditions he so vividly, and, to a lot of us, with most painful truth, describes *in the same issue* at page 28?

While this instrument will undoubtedly do away with a lot of juggling with dimensions, which is the lot of the pattern maker on some classes of work, it will not (and neither will anything else, so far as I can see) make allowance for the molder. So what is the use of working to micrometrical dimensions, even if these are simplified by having two definite points to take the dimensions from? No, friend Barrows, my experience of molders and molding, though I admit it is not a very wide one, is that no instrument which is applied to the making of the patterns will insure accurate castings; and your experience, which no doubt has a lot more weight than mine, seems to show this also.

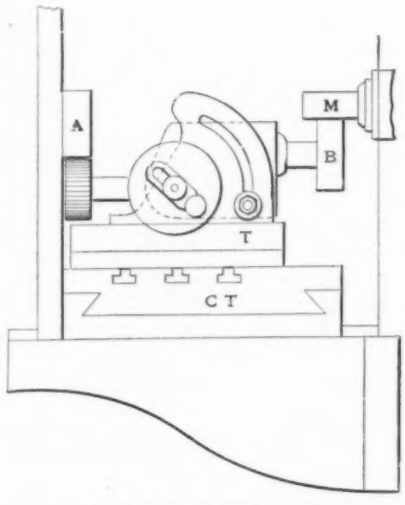
I hope Mr. Barrows will not take this as an attack on his instrument, but rather to show the uselessness of applying it, or any other instrument, for the attainment of accuracy in the pattern, which is never followed up in the casting. I know lots of patternmakers who use nothing in their work, for measuring purposes, except an ordinary 12-inch steel rule; and I might say that the standard allowance for contraction, on general work in cast iron over here, is to the best of my knowledge 0.1 inch per foot.

RACQUET.

England.

Another Way of Milling Cams

On page 86 is described a method of milling cams that induces me to show the readers of the AMERICAN MACHINIST a



ANOTHER WAY OF MILLING CAMS

device for milling cams that I think is very simple in its construction. It requires no angular drive or special fixtures, except a short piece of straight rack the same pitch as the gears used on the dividing head. This piece of rack is bolted to the truss rods or braces, and connects with the gear on the dial or with one placed directly on the head spindle.

As there are various types of machines, the placing of the gearing must be modified to suit the machine. It may be necessary to throw out the indexing worm or disconnect the table screw. When the table is moved with a rack and pinion, this is unnecessary. I make this statement for

fear some of the readers may think the device unmechanical.

Referring to the sketch, it will be noticed that the dividing head is bolted to the auxiliary table *T* and this bolted on the cross table so that the head faces the end mill *M* placed in the spindle of the machine. Feeding the cross table *C T* gives the cam marked *B* a rotary and also a horizontal movement.

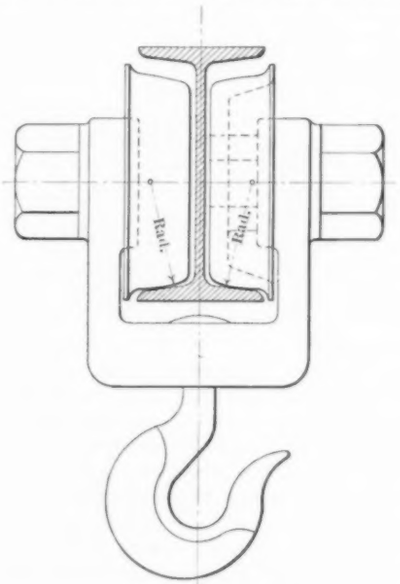
To try to tell what the results or possibilities would be would make a long story. Placing the rack above or below the gear, setting the cutter on the center, above or below it, revolving the cam toward the cutter, or from it, would make an interesting study. One may be able to cut a scroll or mill an involute of a circle. If some of the readers of the AMERICAN MACHINIST who have the time wish to experiment on it, they can easily place a piece of paper on a disk and use a pencil in place of a cutter, and lay off cams that I think would make very interesting reading or scrap book.

There may be some very simple but fixed rules for laying off cams by this method, and we may find someone to point them out to us; and they may be just as essential to the milling-machine man as the method of differential indexing which I gave to the readers of the AMERICAN MACHINIST some years ago.

BENJ. C. NOBLE.

I-beam Trolley Design

A design of an I-beam trolley came to my notice, several years ago, which was originally designed to have conical wheels, and which has (and rightfully, too) been



AN I-BEAM TROLLEY

so adversely criticized analytically by C. D. King, at page 745, Vol. 29, Part 2, and by Hoy Bradley, who offered an elaborate design of trolley, at page 773, Vol. 29, Part 2.

After the trolley was built, of course the wheels would not turn, but only slip. The making of a new design of bracket, similar to that designed by Mr. Bradley, could not be undertaken as the spread of the arms would interfere with parts of the building, the clearance space being very limited.

The way that the trolley was made efficient was by turning off the wheels with a radius as shown in the illustration, thereby giving a line contact between the wheels and the I-beam. No trouble has since been reported about this trolley. S.

A "Putting-on" Tool and How It was Successfully Used

Fig. 1 shows a brake-drum flange for an automobile, made out of a machinery-steel stamping, and bored, faced and turned all over. The spigot on the front of the flange is 3/32-inch thick and 6 inches di-

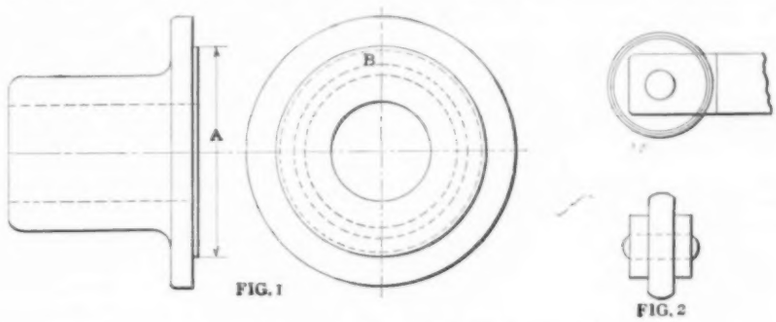


FIG. 1

FIG. 2

A PUTTING-ON TOOL AND THE WORK IT DID

ameter, as shown by the line *A*. It is necessary that this dimension should be accurate to gage, and absolutely interchangeable, otherwise trouble would occur in assembling, and, more important still, the brake drum, which is of gray iron, and recessed out to fit this spigot, would not locate itself dead central, and consequently the brake would not act properly—a vital point in automobile construction. We put these flanges through the shops in lots of 200 at a time, men working night and day shifts on them. When we came to inspect the last 200, which a careless workman had been operating on, we found the spigot turned from 0.005 to 0.015 inch small, and the inspector condemned them as scrap, as this was the dimension of vital importance. We took them back into the shop, and got a square steel bar 1⅛x1⅛x12 inches, and milled a slot ⅜-inch wide across the end, as shown, to take the hard steel roller, 1⅝ inches diameter, and turned to a radius on the top. Fixing this tool, Fig. 2, in a Blaisdell lathe, we drove the flanges on to a mandrel and ran them at a peripheral speed of 150 feet per minute, and brought the roller to bear on the face, as indicated by the two dotted lines surrounding *B*. It took just three minutes to bring them well above the required size. They were then skimmed up over the top with a tool and sized with a micrometer. Upon looking at the flanges you could not tell they had ever been doctored; but, upon putting a straight-edge across the face, you could just discern a slight indention where the roller had run.

"AUTO ENGLAND."

Handbooks Designed for College Men and Handbooks for Machinists—Proposed New Department for Technical Journals—"Information for Sale"—Satisfactory Use of the Enlarging Process for Photographs

I am glad to see that, while my own contributions of late have contained little but negative information, they have been the means of stirring up some of the rest to send in something more useful. I am glad, also, to have someone arise and tell us that the information we so often seek in vain is right there in the pocketbooks, especially if, as does Mr. Cardullo, they give us some hints on extracting this information.

Mr. Cardullo's defense of Kent (page 849, Vol. 29, Part 2) certainly seems to be based on a thorough familiarity with that volume, and I hope to profit considerably by some of his suggestions. Doubtless others will find them helpful in the same way; for beyond doubt Mr. Cardullo is right in saying that I, in common with thousands of others, do not get all I might from the handbooks or pocketbooks, simply because I do not know how to dig it out of them. And if, as he says, Kent and the others of that class are intended for the use of the college man, then such as I have no cause to berate them for not supplying information reduced to such form that the common shop man can assimilate it. But if the foregoing must be conceded, then, as a very common sort of a shop man, I respectfully opine: First, that some mention of such fact should have been made in the preface, that the common shop man might see at the start that the contents of the book were not arranged with regard to his use and understanding; second, that the dealers in these

books should so indicate them in their catalogs and lists that a prospective customer can form some idea whether he is competent to extract from them much that will be useful to him; and, third, that if all the handbooks of reliability and standing were planned principally for the use of college men, then it is high time some genius arose who can so transcribe the thoughts and deductions of the major master-minds that not only the minor master-minds but the thinking machinist can be reasonably sure of his footing when presuming to stray into these hallowed precincts.

A "FIVE-DOLLAR COLLEGE EDUCATION" WHICH REQUIRES A COLLEGE EDUCATION BEFORE IT BECOMES AVAILABLE

Mr. Cardullo quotes one of his students as saying there is in the pages of Kent a "complete college education for the insignificant sum of five dollars," but admits that along with some "free gold" there is much "chemically combined" information which cannot be extracted without special mental equipment. That seems to me somewhat like saying there is a complete college education in the book, but that a college education is also required in order to make use of it.

Right here is where there is room for a big improvement in such books; not all of us know the difference at sight between free gold and that which is chemically combined with foreign and unknown matter; and as a result of this ignorance we not infrequently spend much time and labor in pecking away at a chunk of information which seems to be of the first mentioned variety, only to have it prove a hopelessly intractable mass of the latter. This may be very good mental discipline, but it is mighty discouraging to a fellow whose orders are to "get there" with the utmost celerity and not be too fussy about insignificant details and wire-drawn theories. He can't afford to spend his time that way.

I quite agree with Mr. Cardullo that a few minutes' browsing in the neighborhood of page 325 in Kent's book gives one enough information to start a small brass foundry; but said browsing has left me as hungry as ever for the tensile strength of average brass castings as turned out by the average brass foundry, or even that of drawn brass wire. Of course, if all castings were tagged with the various proportions of their elements one might be able to arrive very accurately at their physical properties from those tables of alloys that Kent gives; but the most useful table in the lot, to a common sort of man, is the one on page 325 giving the composition of alloys in everyday use; and it makes no mention of the tensile strength or other properties of these alloys. The extract from Kirkaldy's tests on page 327 really does not seem to be any better, as, while the strength of phosphor bronze is given, no mention is made of the proportions used in the particular sample that was tested.

The ordinary machinist or shop man has to deal with ordinary and average materials, and to be of much help to him rules and formulas must be based on such. Of course this knocks out anything like extreme accuracy at the start, but such is not required by average conditions. When a concern reaches a point where they can employ a chemist in order to assure themselves that their foundry is turning out an absolutely uniform product, they can also afford the services of an engineer whose educational deficiencies do not have to be pieced out by the "Answers for the Anxious" column of the technical and trade papers.

THE TRADE PAPERS CONTAIN INFORMATION IN THE SHAPE DESIRED BY THE SHOP MAN

In all probability there will never be a handbook written that will be as helpful to the self-educated shop man as these same trade papers. In their columns the workman reads of the trials and problems that beset his fellows, and frequently of their satisfactory solution. Such actual and up-to-date examples come home to him with a force and clearness that books do not often give. Sooner or later he takes one of his own problems to his trade paper and his fellow readers; and they being largely, like himself, men who can see the case only from the shop side, help him to find the shop solution, which is the one he is usually after.

I well remember a case of this sort that once came up in the correspondence department of a paper devoted to the interests of woodworkers and sawmill men. A tapering stick, square at each end, was to be cut at such a point in its length that both sections would contain exactly one-half the cubical contents. Several incorrect solutions were submitted, and a college man generously contributed of his time with a couple of pages of algebraic work that was Greek to a sawmill operator. No one questioned the accuracy of *his* solution because no one could tell what it was all about anyhow. Then someone blossomed up with a graphic analysis that was incontestibly correct, and so simply and clearly put that a 12-year old boy would see all sides of it in two minutes.

PRAISE FOR THE MANUFACTURERS' HANDBOOKS

Mr. Cardullo calls my attention to page 124 of the 1900 Carnegie handbook. I can find only the 1893 and 1903 editions, and in these I fail to find anything which looks to me like instructions for working out the rail problem I spoke of in my former article, though I have probably, first and last, found more real help in Carnegie's and similar manufacturers' handbooks than in Kent, Trautwine, Nystrom and Suplee.

They do not, in the first place, take it for granted that their readers already know pretty nearly everything they need to, and in the second place they have no hesitation in saying that, for instance, the tensile strength of average brass castings is 18,000 pounds, and of hard drawn brass 48,000 pounds.

What could be more lucid than the way the flexure of beams is presented in the Jones & Laughlins handbook? On pages 209 and 210 of the 1893 edition there is more real help for the shop man who is ambitious to know the difference between a cotangent and appendicitis than he could get from many more pretentious books. This information was the means of enabling me to get at the exact angle to which a pair of unequal bevel frictions should be turned. Before I got hold of it there I had to lay out the frictions full size and carefully measure the contact slant with a protractor. In all probability this information is in every one of the pocketbooks above named, but in the Jones & Laughlins book it appears as free gold, quite free from chemical affinities and combinations that befog and bewilder the lay mind. Another most useful and instructive handbook is issued by the National Tube Company. We shop fellows are under obligations to several such concerns for the generous way in which these books are usually distributed, and for the helpful nature of their contents.

A CORRESPONDENCE SCHOOL CIRCULAR WHICH SUGGESTED A GOOD SCHEME

Not long ago I received a prospectus and letter from a certain correspondence school of photography, which was worse than the one Osborne got, because it was a shameless imitation of the sort usually sent out by the worst of medical fakirs. It almost scared me into believing that if I didn't take their "course" at once I was doomed to premature decay in all matters photographic. On sober second thought I concluded its lurid promises and ingenuous premises were the result of a desire to see just how much a brand new polychrome typewriter was good for in the way of emphasis and eye-catching. Doubly underscored and blazing in red were offers and "guarantees" to make of me such a photographer as the world is waiting for, and likely to wait a while longer for, as far as I am concerned.

But buried under all this absurdity there was a grain of common sense, and the germ of an idea that I hope to see develop and mature in other lines than photography. For a consideration they agreed to answer any question that might be submitted, on receipt of which they would advise free how much money must be forwarded to obtain the information desired. Now that was a good, straight business proposition, and granted they were reliable and would frankly admit it when they got a poser which was unanswerable, they were offering a mighty good thing to amateurs who often spend lots of dollars and time in finding out by trial what has long been known to most of the profession. Such an institution would fill

a want which the correspondence schools do not; for a man who has picked up such a trade as drafting, for instance, and is entirely self-taught in it, but has followed it successfully for years, cannot afford to go back to the beginning of a "complete course"; but there are little points cropping up now and then which he would be very glad to pay for having explained clearly.

AN "INFORMATION FOR SALE" DEPARTMENT IN TECHNICAL JOURNALS

Unfortunately, as far as this particular institution is concerned, I was forced to conclude they were out on a hunt for shekels, with little regard to the value given in exchange; but just suppose some reliable "consulting engineer" were to start such a thing under the patronage of and in connection with a trade paper like the AMERICAN MACHINIST. Without some alliance of that sort he could not keep in touch with those who stand most in need of his services, and without special remuneration no trade paper could afford to handle questions not of general interest. The combination, however, seems to me peculiarly felicitous and feasible. It might even be carried to a point where the best part of that "complete college education for five dollars" would be made available to the man in the backwoods who is now unable to find all the free gold, let alone that which is chemically combined. At one time I did apply in this manner to a well known engineer for help in designing an important machine where failure would have meant disaster, and the assurance of such a man was worth a great deal. We were able to arrive at a very clear mutual understanding by mail, and his fee was very moderate; in fact so extremely moderate that I never felt free to apply to him again, fearing he had done the work largely as a favor, and did not wish to be troubled with more of it; though aside from the low price there were absolutely no grounds for such a supposition on my part. Had he been running an information bureau of that sort I should have been glad to take more of my troubles to him at "so much per troub." to our mutual advantage.

AN INSTANCE OF ADVICE WHICH PROVED VALUABLE

Some time since I was standing at a fork in the highways of photo work, quite uncertain which road to choose. If I took the one it meant large contact prints, expensive plates, darkroom development, and a camera far too bulky to take on a hunting trip or on a wheel. On the other hand were the attractions of the pocket camera—or very nearly that—and tank development, and of small, conveniently stored and comparatively cheap films, offset, however, by the necessity of enlarging them in some way or other. Just at the opportune moment I found in one of my photo journals an article by a well known professional whose writings are not unknown in the columns of the AMERICAN MACHINIST. It bore directly on the point at issue, and with apologies for my presumption, I wrote and begged him to advise me which path was most likely to lead to success. In reply I received one of the most cordial, friendly and helpful letters it was ever my good luck to get, and he has been kind enough to supplement it with further details; but would any of you feel at liberty to "work" such a good friend as that the way you would a fellow who was regularly selling his helpfulness at "so much per"? Of course you wouldn't if you are the sort worth helping.

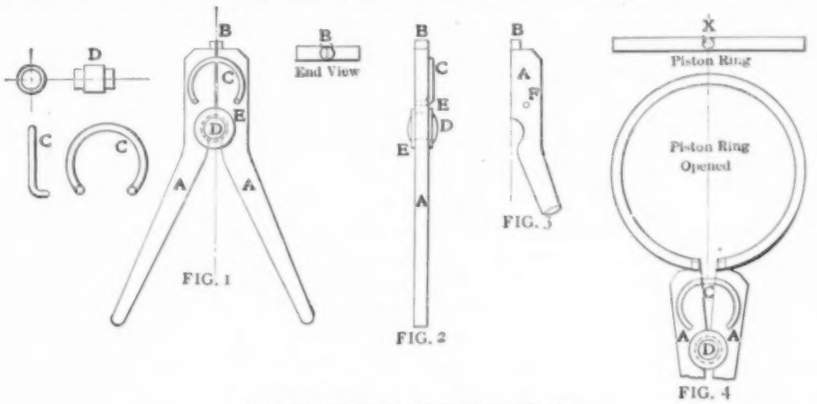
Perhaps I had better add that this expert's advice was to stick to my little films, and to invest in a good enlarging lantern. Daylight will do after a fashion, but strictly first-class work is only possible with a first-class lantern. It is quite possible to get a fine 16x20-inch from a 3¼x4¼-inch film; and I have one film of a machine, taken while surrounding machines were in operation, with no screens or special preparation of any kind beyond a few chalked corner lines, that enlarges to 24x36 inches without noticeable defects becoming visible.

Who will come to the help of the shop man with technical information at "so much per"? E. R. PLAISTED.

A Simple Tool for Expanding Small Piston Rings into Position

The sketches show a very simple, homemade pair of pliers for expanding small piston rings into their pistons, a somewhat tedious operation to perform with the fingers with the attendant danger of breaking the rings. *A A* are two strips of mild steel ½ inch wide by ¼ inch by 5¼ inches long, bent and filed as shown in Fig. 3, the top end *B* being filed round 3/16 inch diameter as shown. *C* is a spring made out of 16-gage steel wire, the ends of which are inserted in the holes *F* as shown in Fig. 3. *D* is a shoulder rivet ⅜ inch diameter with a washer *E* riveted on each end as shown in Figs. 1 and 2. The two levers *A* are placed around *D*; *C* is then inserted in the hole *F*, and the lot are held rigidly together, *D* acting as a fulcrum, the spring automatically closing the top end *B*.

The piston rings, which are for petrol motors, are 3 13/16 inches diameter by ¼ inch wide, have a 3/16-inch round hole drilled in them and split across as shown



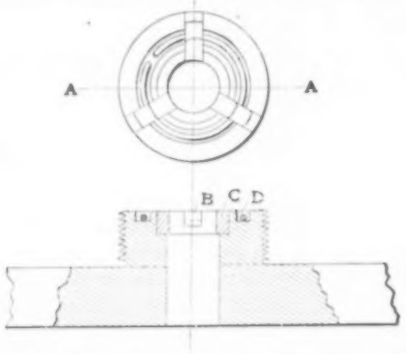
TOOL FOR EXPANDING PISTON RINGS

at *X*. The hole fits a small peg which is screwed into the groove in the piston, and prevents the rings from turning round and all the joints from working together, and thus letting the gases escape. When three rings are employed the pegs are staggered 120 degrees apart. Fig. 4 shows how the pliers are used; the ends *B* are inserted in the hole *X*, and the rings are then sprung open and placed over the piston into position without further trouble.

"SWIFT ENGLAND."

An Extractor for a Shell-drawing Die

The "extractor for a shell-drawing die" illustrated on page 708, Vol. 29, Part 2, by C. Petitjean, appears to me a very good one. I offer a few suggestions for improvements which do away with spiral springs back of the extractors and the necessary screws to give them tension. The sketch shows the three shell extractors *B* recessed and operated by one split-ring spring *D*, which is recessed. The ring *C* will prevent the raising of burs, which invariably takes place when extractors are used in drawing a shell. The ring is slotted with clearance to allow the extractors to pass through freely. It is made of tool



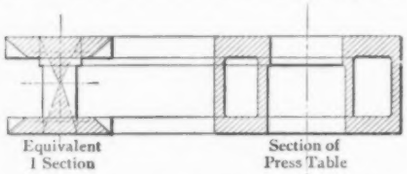
AN EXTRACTOR FOR A SHELL-DRAWING DIE

steel, hardened and ground to the exact size of the shell. The die and the nut for holding the die in position are not shown.

W. F. HOFFMANN.

Reducing a Beam Section to an Equivalent I-section

Mr. Plaisted, in his letter at page 677, Vol. 29, Part 2, stated that he was not able to find a method of reducing any sec-



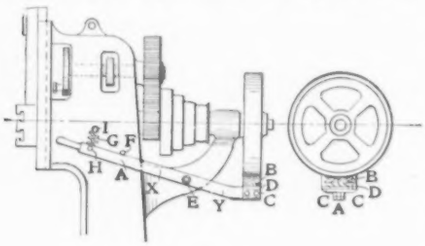
REDUCING A BEAM SECTION TO AN EQUIVALENT I-SECTION

tion to an I, as referred to by me at page 384. The method is illustrated in the accompanying sketch, applied to the section of a press-table; the sketch explains itself.

England. F. M. B.

A Brake for the Slotting Machine

The sketches show the general arrangement of a brake which we fitted to a 12-inch stroke slotting machine. It is very simple in construction and acts admirably, as the machine can be suddenly stopped when on the top of its stroke, by the application of the brake. Anyone who has operated a slotter will appreciate this, as it is a very difficult operation to stop the machine at the required position, without walking round to the fly-wheel at



A BRAKE FOR A SLOTTING MACHINE

the back, which causes much delay and loss of time, especially when on intricate work where the machine has to be frequently stopped to gage the work under operation.

A is a mild-steel lever 3 inches x ½ inch section, bent at *X* and *Y* to follow the outline of the machine, the latter bend being to get in the center of the fly-wheel. *B* is a wooden brake block resting on *D*, which is a mild-steel plate ½ inch thick by 3½ inches wide by 10 inches long, which in turn rests on the two short angles *c c* which are riveted on to *A*. Two coachscrews, ⅝ inch diameter, fasten *B* to *C*. *E* is a fulcrum pin ¾ inch diameter screwed into the frame of the machine as shown, on which *A* is pivoted. *F* is a pin ½ inch diameter, also screwed into the main frame as shown, and serves to keep the lever from vibrating when the spring *G* pulls *A* up against it. *I* is a pin ½ inch diameter from which the spring is suspended. *H* is a hole drilled in *A*, to hang the spring in, and thus *A* is brought to bear against *F*, and the brake block *B* brought clear of the fly-wheel, the handle at the front end being depressed to brake the machine.

ROVER.

England.

Science in the Foundry*

BY WILLIAM W. HEARNE

The selection of pig iron, its mixing and melting in the foundry, are becoming a matter of much more interest than formerly. Twenty-five years ago there was not a foundry in the United States that had a chemist in its employ, and scarcely a blast furnace running on foundry iron had a laboratory. Foundry pig iron was bought, sold, and mixed, entirely by its appearance and the experience the foundryman had had with the same brand previously. At that time this was a comparatively safe and satisfactory method to pursue, for the reason that at that time the ores and fuel from which each furnace made its product were largely drawn from local sources, and the name of the district in which the furnace was located told from what the iron was made.

The great growth of the iron industries since that time, the development of the railroad systems and the increased facilities the railroads offer for the assembling of materials, the discovery and development of coking-coal fields, the development of the Lake Superior orefields, and the cheapness with which this ore can be transported on the Great Lakes to widely distant points have changed this situation entirely. Furnaces in Milwaukee, Chicago, Detroit, Toledo, Cleveland, Buffalo, the Mahoning and Shenango valleys, in southern Ohio, in Pittsburg, in central New York and in central and eastern Pennsylvania, can and often do run on almost the same mixture of ore smelted with the same coke.

This makes it necessary for the foundryman to know either the analysis of the pig iron, or the ore and fuel that are used.

There are still furnaces in the country, notably in Virginia, that are run exclusively on their own local ores and local fuel. The foundryman who is so fortunate as to be able to obtain this iron does not need to have a laboratory, for he knows from experience exactly how this iron will work, and how much of a certain character of scrap this iron will carry to make a certain kind of casting. The fact that these furnaces are comparatively small and are run with a low blast pressure, and that the local ore and fuel are almost entirely free from sulphur, of course all help to make an ideal foundry iron.

The chemistry of foundry practice is one of elimination, and this has been the cause of the almost limitless specifications. Really there is practically no positive knowledge, but all knowledge has been acquired by experiments, and most of these experiments have been made by men having preconceived ideas of the results to be attained. This, of course, is natural, and is probably the only way to go about it. The result is that an experiment is made with iron running silicon, 2.50, phosphorus 0.80, sulphur 0.035, manganese, 0.40 and the experimenter discovers that he has made a satisfactory casting. Consequently when he wants an iron for this kind of work he demands iron of exactly this analysis, not knowing whether or not, if he had iron of silicon 2.00, phosphorus 1.10, sulphur, 0.05, manganese 1.25, he would get the same result and possibly a much better and sounder casting; for the phosphorus is if anything a greater fluidizer than the silicon, and the manganese is a powerful oxidizer. When the second iron is melted he would lose at least one-third of the manganese, and with it would go the sulphur from his iron and possibly some picked up from his fuel. This will be especially true if he will tap his iron from the cupola into a big mixing ladle so as to give the manganese time to act.

The fact of the matter is that the foundry cupola is a very poor thing in which to make a mixture of iron, and very little reaction goes on there beyond the loss of a little silicon and the taking on of some sulphur. Besides, the slags of most cupolas are too acid, and much manganese is lost which ought to be carried forward into the mixing ladle, when it could be used to eliminate the sulphur. There is not nearly enough lime or fluorspar used by foundrymen. If the ordinary foundryman would introduce a little fluorspar into his molten iron, he would be surprised at the amount of sulphur he would smell.

There are four things necessary for a good foundry mixture: fluidity, soundness, softness and strength. How is fluidity to be attained? First, by hot melting; second, by the presence in the pig iron of certain alloys—carbon, silicon, phosphorus and manganese—and by freedom from sulphur. Practically pure iron is white and will not run at all, but will melt into a sponge and burn before it will run.

In ordinary foundry pig iron there is about 93 per cent. of metallic iron and about 7 per cent. of alloys, and it is the proportion of these alloys to each other that determines the character and grade of the iron.

The real softness of a casting depends on the total amount of carbon and on the proportion of graphitic to combined carbon. This every foundryman knows, and

*Paper presented at the New York meeting of the American Association for the Advancement of Science.

the real problem is how to get the proper proportion. Every foundryman knows that one sure way is to anneal the casting or to cool it slowly. This is expensive and only to be done when he has failed to handle his mixture or his pouring properly.

In pig iron the proportion of free, or graphite, to combined carbon depends entirely on the rate of cooling, and the slightest accident at the time of casting will affect this proportion and will change iron which should be 2 X foundry to 2 plain or 3 foundry. In the old days many blast-furnace men took advantage of this fact and made their pig molds short and fat so as to open the grain. As a result iron, that in silicon and sulphur would have been 2 plain, by cooling slowly became 2 X foundry. Really, however, there are more chances for the furnaceman to lose than to gain, as anything which impedes or interferes with the running of the iron will tend to combine the carbon, and it is a common thing to get 1 X, 2 X, and 2 plain or 3 foundry iron in the same cast, in which case all three grades will have the same silicon, sulphur, phosphorus and total carbon, and will vary only in the proportion of combined to graphitic. All this relates to the mechanical causes of the proportion of the carbon.

Chief among the foreign elements in pig or cast iron that affect the carbons chemically is silicon. This element has the property of throwing out of solution the carbon in the graphitic form, and many melters seem to think it the only cure for all hard iron. Everything else being equal, it is safe to say that an iron carrying 2.50 per cent. silicon is a softer iron than one carrying 2 per cent. silicon. Silicon is not in itself a softener; it acts so only by affecting the carbons. An iron with 10 per cent. silicon can scarcely be drilled. Pig iron with 4 per cent. silicon will not contain as much total carbon as one of 2.50 per cent., as the silicon unites with the iron and robs it of some of its carbon; so that a high silicon pig iron never has the dark, open fracture of a 2.50 to 3 per cent. silicon iron.

Sulphur is the most dangerous enemy of soft sound castings, as it not only tends to combine the carbon but by doing this also causes the grain to close up quickly, and to retain in little holes or sacks gases which might and should escape. In this way it causes the casting to pit and be porous.

If iron can be kept fluid long enough the sulphur will all rise through the iron and pass off, as can easily be proved by drilling holes in any piece of iron of reasonable size, poured in open sand. If three holes are drilled, one above the other, the proportion of sulphur in each set of drillings will vary as the hight. This was demonstrated ten years ago by Guy R. Johnson in a series of more than a hundred experiments. The problem, then, is to give the sulphur a chance to get away before it is locked in the casting. There are many ways to do this, but the easiest and simplest is by using an iron carrying a fair percentage of manganese, with a large mixing ladle. In special cases it can also be done by putting into the mixing ladle a small amount of pulverized ferro-manganese, or a small amount of fluorspar or of aluminum. Any of these additions will cause the iron in the ladle to boil, and during this boiling the sulphur will be thrown off, and, as your molder will say, the iron is cleaned. Being free from sulphur, your casting will be soft, as it will have the proper proportion of graphitic carbon. Most of the so called patent fluxes for making semi-steel castings are nothing but pulverized ferro-manganese, fluorspar, and pulverized high ferro-silicons. Every foundryman can obtain these alloys himself and make his own fluxes.

There is a brand of iron made in Virginia, from ores mined on the property smelted with coke, made by the company that demonstrated the futility of grading pig iron by silicon and sulphur alone. A certain foundryman took an iron made in western Alabama, analyzing: Silicon, 3.25 per cent.; phosphorus, 0.90 per cent.; sulphur, 0.05 per cent.; an iron from Birmingham, analyzing about the same, except that the phosphorus was about 0.75; and the Virginia iron, analyzing: Silicon, 1.50 per cent.; phosphorus, 1.15 per cent.; manganese, 1.00 per cent.; sulphur, 0.005 per cent.

The three irons were melted under identical circumstances and were poured into molds 1 inch wide, ⅛ inch thick and 14 inches long, for a fluidity test. The first iron filled the mold for 9¾ inches, the second for 8½ inches, the third for 14 inches, and the foundryman said he thought if he could have got the end of the mold out quickly enough, it would have run to the end of the shop. This of course was an enthusiastic exaggeration, but the test settled in that foundryman's mind that phosphorus and manganese were elements that affected the fluidity of iron fully as much as silicon; also that an iron that had this fluidity must also be low in sulphur. The product of this furnace is used almost entirely by foundries making steam, gas, and air cylinders, ammonia valves, and other castings that need to be dense and free from pin holes and yet soft enough to be reamed and cut.

The casting of pig iron in chill molds has very little if any effect on the character of the iron, especially if the foundryman uses a mixing ladle. It does not affect the total carbon at all; if anything it rather increases the amount of this element, for the reason that the surface of the pig iron is cooled quickly, in this way preventing the throwing off of "kish," which is so evident in a cast house when running "hot" iron. It somewhat increases the total combined carbon, owing to the sudden cooling or chilling of the surface; but if the iron contains the proper amount of alloys and is melted hot and tapped into a mixing ladle the casting will be as satisfactory in every respect as though the pig iron had been sand cast. In addition the chilled casting eliminates one source of trouble, i.e., the sand or other dirt in which the sand-cast pig iron is run.

A test was made several years ago by taking a pig of sand-cast iron, weighing it, pickling it, and then reweighing. By calculation it was found that the particular brand of metal carried 70 pounds to the ton of sand. This adds just so much to the impurities to be contended with. In addition, it is a fact that iron free from sand melts more quickly than iron coated with it.

Dr. Goss to Investigate Superheated Steam in Locomotive Service

The Carnegie Institution of Washington, D. C., has made a grant of $3000 a year for a period of four years to Dean W. F. M. Goss, of Purdue University, Lafayette, Ind., for the purpose of determining the value of superheated steam in locomotive service; first, in connection with single-expansion engines; and second, in connection with compound engines. This is the second grant which the Institution has made to Dean Goss. While given to him personally, its effect will be to stimulate and to make more effective the work of the Purdue locomotive laboratory. Funds thus received will be employed in supplementing the resources of the laboratory as derived from all other sources.

The results of Dr. Goss's previous research under the auspices of the Carnegie Institution, which was for the purpose of determining the value of different steam pressures in locomotive service, and of which a very brief account was given at page 808, Vol. 29, Part 2, are now in press.

Smokestacks of locomotives in Great Britain are not supplied with screens to prevent the emission of sparks and big burning cinders. Such a device is said to be used, however, for traction engines employed for agricultural purposes. Complaints of burning cinders have been very numerous this year, and it is suggested that the English railway managers should immediately adopt spark arresters, such as are used in the United States.— *Industrial World.*

We understand that the United States Steel Corporation has just purchased 3000 acres of land at Gary in addition to its present holdings, so as to be well fortified to take care of future enlargement of the plant.

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Grammar

In the visits which the members of the staff of this paper make from time to time to various machine shops, it is a common experience to meet someone in, perhaps, a subordinate position, who has ideas and who has done work eminently suitable for publication in our columns. Under these circumstances, we often extend an invitation to contribute articles for publication, to be met, frequently, with some remark like the following: "Oh, well, now, I cannot write anything worthy of publication. I left school when I was 12 years old, and cannot write English in a manner which you would be willing to publish; and while you are welcome to any ideas that I have, it is out of the question for me to think of writing them up myself."

Such answers as this show an entire failure to appreciate the work of an editor, which, to a very large degree, is the correction of other people's grammar and spelling. The tendency to place grammar at the head of the list of requirements in contributed matter, or in any prominent place in such a list is really amusing to an editor. The man who puts the grammar ahead of the ideas would not think, after he had built some splendid machine, and then turned it over to someone else to polish up the brass work, that he was thereby showing his own incapacity to make the machine complete; and yet this is precisely what he does when he imagines that he is unable to write because he is a little weak on grammar. The grammar and the spelling of an article are nothing but the paint and polish, which it is perfectly easy to find someone to put on, while the man for whom we are looking is the one who can do the really important work. Grammar is like a man's necktie which, though necessary for the sake of appearances, does little that is really useful.

We wish our doubting readers could see some of the manuscript that comes into this office and know some of the sources from which it comes. If our readers imagine that all college professors can write English which would be presentable in type, they are very much mistaken, the fact being that manuscript from such sources requires editorial revision to a degree that they would scarcely believe. And does the editor buy a larger hat when he corrects the manuscript of a professor? No, because the printer and the proofreader even up the matter with him by correcting his manuscript in turn.

There is not one college graduate in twenty—we would put the figure higher if we thought that we would be believed—who can prepare manuscript that he would not himself be ashamed of, could he see it reproduced in type exactly as he prepared it; the queer thing about it being that errors which entirely escape one's eye in the manuscript will stare him out of countenance from the printed page. The niceties of printed English are found in no grammar and taught in no school. The printer and the professional English scholar are the only ones who know them, and in a contest between the two, we would lay long odds on the printer winning.

We wish our readers would understand that grammar is a bagatelle, which it is the editor's business to look after, and that a difficulty which seems so formidable to them is in reality no difficulty at all.

Schedule of Foreign Tariffs on Machinery

The Bureau of Manufactures of the Department of Commerce and Labor has undertaken a very useful piece of work for all exporters of machinery. The Bureau has compiled the rates of duty on machinery as imposed by various foreign countries, the resulting schedules being published serially in *Daily Consular and Trade Reports*. The first section appeared in the issue of February 1, and, at the time of writing this, additional lists have been published, so that Austria-Hungary, Belgium, Bulgaria, Denmark, Finland, France, Germany, Greece, Italy, the Netherlands, Norway, Portugal, Roumania and Russia have been covered. The list as published includes machinery and machine tools only, farming implements, hardware and like commodities, usually classified in tariff schedules under machinery, being excluded from the present list. They will, however, be given in a later list to follow the one now being published.

The list is of such obvious usefulness that many of our readers will be glad to know that it can be obtained gratuitously by addressing the Bureau at Washington.

The Motor-propelled Omnibus Growing in Favor in Paris

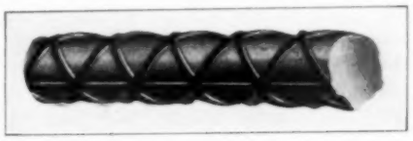
The motor omnibus, according to an account sent us by a reader in Paris, is quite a success in that city and is likely to continue to increase in number. We notice also that the hybrid word "motorbus", like that other hybrid, "automobile," seems to be becoming firmly established in France, as in the English-speaking countries. Since the service to the automobile show, to which we referred last year, three new lines have been started, and still others are proposed. Our correspondent sends us a picture of one of these vehicles, which are apparently about the size of the big new automobile stages on Fifth avenue, New York; the seats on the top, or "second story," are roofed over and protected by a closed and glazed front. Although the fares are somewhat higher than the ordinary cab tariff, the superior comfort and speed of the new vehicles over the cabs insure patronage.

NEW TOOLS AND MACHINE SHOP APPLIANCES

A REINFORCING BAR FOR CONCRETE WORK

The casual observer while watching concrete construction work is not apt to be impressed with the importance of the bars used for reinforcing purposes. They are a lot of rusted, twisted, irregular bars, that would look more at home in a scrap heap than in a sky-scraper. But because such bars are used is no reason why one should suppose that they are the best for the purpose to which they are put, or that any old scrap is good enough for concrete construction work. As a matter of fact, the direct opposite is the case. Bars of good material, properly designed to meet the requirements of construction work, should be used, because they are hidden from view, quite inaccessible and impossible to repair or replace.

A reinforcing bar for concrete, to be efficient, should fill many conditions. It must have uniform cross section; uniform elongation; uniform and sufficient holding power; it should be economical, and, in order to fill this condition no metal should be wasted to provide holding



A REINFORCING BAR FOR CONCRETE WORK

power, or bond *only*, but all the metal in the bar should add to its strength, and act in tension, when the bar is in service. It should be of such shape that it readily engages the concrete when deposited; it should have no sharp edges or corners to cut into the concrete, as these tend to crack the concrete when under stress; it should have no tendency to twist or turn under stress.

The bar shown in the illustration was designed to fill all these requirements. In general appearance the bar is round, with spiral projecting ribs running around it in opposite direction. These prevent the bar from having any tendency to twist or turn under stress. As the ribs are of equal hight rounded off at the top and base, the bar engages readily with the concrete and cracks are avoided. Two longitudinal ribs which run down opposite sides of the bar occur where in the rolling process the upper and lower rolls meet. They facilitate the flow of the metal during the rolling process and make it unnecessary to gear the rolls together, as it is immaterial whether the diamonds on the upper roll meet those on the lower or not. All ribs are uniform in hight and of similar cross section; consequently any cross section of the bar presents the appearance of a circle surmounted by six equal projections.

These bars, from ½ inch to 1¼ inches diameter are manufactured by the Concrete-Steel Engineering Company, Park Row Building, New York.

A NEW SLUSHING COMPOUND IDEA

Warren Brothers, of 93 Federal street, Boston, makers of the Warren slushing compound, taking advantage of the fact that the compound acts as a paste, have supplied to the users of it a printed form giving instructions for removing the compound by the application of kerosene, turpentine, or petroleum, these instructions being printed in English, German and French. The idea is that the ticket shall be pasted to the machine with the compound itself, and thus supply the necessary instruction to the receiver of the machine, regardless of where he may be located.

The compound is applied with a brush, dries quickly, and while easily removable by the means described, is claimed to supply a perfect protection for polished surfaces.

New Publications

A new comer in the field of technical journalism is *Technical Literature* which comes to us from the publication office at 220 Broadway, this city. On the title page, the new monthly describes itself as "A Monthly Review of Current Technical Publications," and from the editorial announcement of its purpose, we gather that it is intended to include a review and index of the more important articles and comments in other periodicals; reviews and announcements of new technical books; and notes from technical societies and colleges, together with original articles, and information on all subjects that can be classed under the head of technical literature. Discussions and general reviews of technical books, inquiries regarding available literature on various subjects, and the interests of the technical press and technical book trades will also receive attention. The subscription price of the new paper is $2 per annum; and judging by its first number, it promises to be a very useful publication.

"Electrical Engineering." By E. Rosenberg. Translated from the German by W. W. H. Gee and Carl Kinsbrunner and revised for American readers by E. B. Raymond. 347 6x9-inch pages with 333 illustrations. John Wiley & Sons, New York. Price $2.

Some years ago the author of this volume gave a series of lectures to the workmen and staff of a large German electrical works and from this beginning his book has developed. It is not intended to enable the reader to calculate the parts and windings of dynamos but to understand their action. The aim of the author has been well carried out and the book can be confidently recommended to the large number of persons who manage electrical machinery or who desire accurate and correct information regarding its principles and construction, but to whom the methods of design are of no importance. The natural result of the author's aim is a very limited use of mathematics and of nothing beyond simple equations. About two-thirds of the book is devoted to direct current machinery and the remainder to alternating current apparatus. The latter is not, of course, as simple as the former, but, even here, there is nothing beyond the comprehension of any earnest, intelligent reader. The book begins with the fundamental phenomena of the electric current and assumes no previous knowledge of the subject by the reader. The American reviser has kept in mind the needs of American readers and added material and illustrations where they are advisable.

A Central Machinery Exchange Opened in Boston

A great convenience to persons doing business in Boston will be afforded by the recent establishment there of a machinery exchange, in the Oliver building, Milk and Oliver streets. The project was originated by Elroy N. Heath, the New England representative of the H. B. Smith Machine Company, manufacturers of wood-working machinery. The plan is somewhat after the style of the Philadelphia Bourse; on the first floor of a modern office building space is assigned to one firm in each line of a variety of machinery and supplies. Numerous facilities are provided for the expedition of business and the comfort of the tenants. The building is always open. Several concerns have located their New England offices and exhibits in the exchange.

Consul F. W. Mahin, of Nottingham, describes an improved British gas mantle said to be as remarkable as the newly invented German mantle, which uses a form of copper cellulose impregnated with certain salts. The new English mantle is dipped in a solution of thorium and cerium, to which is added an ingredient called "laddite," which so increases its strength and life that it has been uninjured after burning 2500 hours.

The Publicity End—A Neglected Opportunity for Free Publicity of Liberal Space for Those Who Know How to Use It*

BY JAMES H. COLLINS

So long as a man has to pay for space in a publication he is pretty certain to bring ability to bear in filling it. Not always, of course—some advertisers let the worn electrotype run till forbid, or until it won't print legibly. But usually the man who pays the bills does the best he can to fill his space intelligently. The more it costs him, the more closely he studies what to say, and how to illustrate it, and who is going to read his announcement.

A NEGLECTED OPPORTUNITY FOR FREE PUBLICITY

Now if you give this same man absolutely free all the space he can fill intelligently, it would seem almost a foregone conclusion that he would use as much care in preparing the copy as he does in filling paid space. He ought to use more. He ought to sit up nights to make the most of an offer like that.

But he seldom does.

This is an offer being made daily to hundreds of concerns manufacturing machinery and supplies, to all the engineers and architects and builders, to the inventors and every person or firm occupying a position in the van of our material progress. "The space is there waiting," say publishers. "If you can fill it properly it is free as salvation." One would think the line of people waiting to take advantage of such an offer would extend clear past the cashier's desk, and out the front door and way around the corner. But it doesn't. On the contrary, when somebody closes with it the publishers are perceptibly shocked.

What sort of publishers?

Every sort. Publishers of technical and trade journals, publishers of magazines and newspapers, publishers of books and publishers of Sunday syndicate stuff.

This free space is used hardly at all. Why? Because the people who might fill it have never given any study to producing the sort of matter that the publishers demand. The latter do not hold the offer open to everyone. A department store gets in only when it has an elevator accident. The actress's pitiful account of how her diamonds were stolen is received with bland indifference. Wall street fills some of it, but in the form of "Frenzied Finance" articles that are not much to its taste.

THE MANUFACTURER'S BY-PRODUCT OF LEGITIMATE NEWS

A big manufacturing plant, however, a great engineering concern, an architect, contractor or inventor, is engaged in enterprises that have a large by-product of legitimate news of general interest. What they are making or doing has direct bearing on the lives and safety, the convenience, comfort and prosperity of thousands of people. Their investigations go into the realms of pure science, and widen both technical and popular knowledge. This is an age of machinery and material development. Our American public not only understands technical facts when clearly presented, but is eager for such information. Just take a year's issues of any popular magazine, or a month's Sunday papers, and tabulate the technical stuff. There you have the demand. If you turn a good newspaper reporter into the average plant where machinery or supplies are being made, or tests of materials conducted, or plans being worked out for building, tunneling, mining, he will come away with columns of entertaining, printable stuff. And the technical editor is continually trying to get, from the outside of such plants, the information that men inside possess and do not know how to present in acceptable shape, or do not take the trouble to.

HOW THE MATTER IS USUALLY PRESENTED

"Oh, bosh!" says the machine or supply man, "We send items to the trade press every little while, and they are never printed."

So he does. There comes to mind one of his items that was lately sent out in good faith to a number of daily papers as automobile news. It is an excellent example. This item was written by a manufacturer of autos who thought the world was vitally interested in the new features of his 1907 car. And so the world might have been had he presented them in the proper way. But he doused his bit of fact in a sea of self-complimentary adjectives. He not only wanted the item to have the name of his car in every other line, but the name of the company, its main office address and branches, its officers and directors. He said a good deal about the progressive spirit of the company, and the benefits it had conferred on mankind, and stated that it was now generally conceded by the public, the press and the crowned heads of Europe that this particular auto had no peers. That was the idea—it was simply peerless. When the editors received this item as news they turned it over to the advertising managers. And what the advertising managers wrote to the auto company must have formed a very pretty exhibition of sarcastic and denunciatory writing.

Yet the auto manufacturer doubtless thinks to this day that he sent out a thoroughly legitimate piece of news. He has probably said "Bosh" to himself a good many times since then, and believes in his soul that the press lacks acumen.

Hundreds of voluntary items and articles of this nature pour in on the newspaper and technical editors weekly. Every business concern attempts at some time in the year to impart what it considers genuine news or information. And usually the basis of its news or information is sound, and the attempt is made in good faith. But perhaps not fifty corporations in this country, apart from the railroads, have any sort of equipment for gathering news in their own plants, dishing it up in acceptable shape and sending it out systematically.

A GROUNDLESS FEAR OF DIVULGING TRADE SECRETS

These voluntary items are all written with one idea in mind. The manufacturer or advertising manager is obsessed with the thought of "What are we going to get out of this?" They want the corporation's name to appear at least once. The text is heavy, like an annual statement passed by the board of directors. Sometimes a groundless fear of divulging trade secrets leads to a caution that would be comic were it not serious. The writers want to get into print, yet do not want to say anything. They are afraid to let themselves go, tell an interesting little story, leave out the company name and trust to the human interest of the stuff to take care of the results. They fail to distinguish between publicity and advertising. If editors printed such matter about a competing concern they would swear the press had been subsidized. They are afraid readers will not be able to infer and draw conclusions. They forget that in their own reading it is the information presented in the most disinterested way that carries weight, and that im partiality of presentation is the basis on which they form judgments.

Instead of "What do *we* get out of it?" substitute two other ideas:

In writing for newspapers and magazines the idea of *entertainment.*

In matter for the technical press the idea of *how to do it.*

People read newspapers to be entertained. To the technical expert, a newspaper reporter's use of technical information seems shallow, sensational, sometimes criminally superficial. He despises the tendency to play up 'big things" and "wonder stories." He would like to enter into the true technical or scientific merits of the thing, with diagrams and floor plans, and consequently his presentation of the matter is as dry as theology. The newspaper reporter knows that self-interest is a large element in popular reading. A new tunnel under the East river is interesting to Bill Smith, not as engineering, but from the standpoint of how long it will take him to get home. A new substitute for celluloid is interesting from the standpoint of making collars and cuffs. A series of wire-glass tests is interesting from the standpoint of how much heat is generated when Bill Smith's house burns down.

*From the *Selling Magazine.*

BREAD-AND-BUTTER INFORMATION ALWAYS INTERESTING

Men read the technical journals, on the other hand, because they want help in their work. Human interest is a minor element here. It has already been created, because Bill Smith's job, and his bread-and-butter, depend on getting practical information out of his trade publications, and that is always mighty interesting. Hundreds of concerns try to get notice in their trade press without giving up any information worth reading. With the fear of competitors in view, they never reason that the competitor who is really alive, and dangerous, and able to use information, will probably get all the data he wants whether they give it out or not. They fail to see that the concern contributing valuable information regularly to technical publications soon becomes known as one conspicuous for its activity and progressiveness. They would like the trade to believe, in effect, that the total result achieved by a high-priced executive, investigating and manufacturing staff the past six months is that:

Thomas F. Jones, president of the American Mill Construction Corporation, visited New York last week on business connected with the company.

A favorite way of giving out information—or what is supposed to be such—is the sending of the company's annual report to the trade press. What is there about an annual report that fascinates the technical mind? The other night a well known authority on charities delivered an interesting talk on his specialty to a New York audience. Any newspaper would have been glad to print it. But next day the society with which he is connected sent out to the papers, not this address, but a copy of its annual report!

LIBERAL SPACE FOR THOSE WHO KNOW HOW TO USE IT

There is no reasonable limit to the space that a live concern might fill in the technical and general press by a little systematization in gathering its news, a little attention to the needs of editors. If there is nobody in the plant who can write the stuff, let an arrangement be made with some capable newspaper writer or trade-journal editor, to come in weekly and look the place over. It is quite possible that the papers will write matter themselves if they are informed regularly of interesting achievements. If the company were going to conduct a series of trolley fender tests, picking up a live man with a car going ten miles an hour, a note of invitation to the local newspapers would bring reporters to the spot. If the company has made something that is bigger in its line than was ever made before, the newspapers are interested. If a difficult installation has just been finished, a note to the trade papers, with offers of such photographs as are wanted, would bring editors on the run.

This free advertising (or, rather, *publicity*) space, is open all the year round to the corporation that can fill it acceptably. Cost of filling it is so low that to neglect the publicity end of an important industry is to overlook one of the places where there is perhaps the greatest opportunity for indirect development of new business. If half as much time, care and labor were given to such publicity as to filling paid advertising space, hundreds of manufacturing concerns in this country would come out of their shells of reserve and indifference, and become as well known to the technical and general public as the Krupp Gun Works or the Pennsylvania Railroad.

[The above from our sprightly contemporary is such an exact presentation of facts, albeit from the purely selfish standpoint of free advertising only, while we necessarily look upon the condition described from an entirely different standpoint, that we cannot resist re-publishing it. The experience of the editors of this paper is that finding material for publication is easy, but that getting the material after it is found is extremely difficult. It is no unusual thing, after an eminently suitable subject for publication has been found and the material for it promised in good faith, for a year and even more to elapse before the material can be obtained, and not infrequently the effort to obtain the material is eventually abandoned. Material exists in the shops of this country which, could it be had, would improve the quality of this paper beyond estimate and make it a paper which no mechanical man could afford to be without, and the strangest part of it is that those works which maintain a department of publicity are usually the very ones from which it is most difficult to obtain the information desired. Such departments regularly send out reams of manuscript which no self respecting paper can publish; but, coöperate with an editor, even after he has pointed out specific things for them to do, they simply will not.

There is nothing which the average manufacturer desires so much from the technical press as space in its reading columns, as shown by the constant effort which they make in order to obtain such space—effort which in some cases is scarcely less than frantic. There are numerous manufacturers who could obtain such space to an extent that would keep their names constantly before the public if they would supply material suitable for publication in the reading columns instead of that which is impossible of such publication; but as a simple matter of fact it is some of these, in which the publicity department is most active in sending us "reading notices" which are impossible of publication but from which nothing of real interest to our readers can be obtained.—Ed.]

Henry C. Sergeant

Henry Clark Sergeant, of the Ingersoll-Rand Company, died at his home, Westfield, N. J., January 30, 72 years old.

Mr. Sergeant was widely known as a highly successful inventor, especially in the line of rock drills, air compressors and mining and excavating machinery in general, his most notable inventions being the Sergeant "auxiliary" and "arc" valve, "tappet" rock drills, the Sergeant release rotation for rock drills and the piston inlet valve for air compressors. He was also the originator of many new ideas in stone channeling, coal undercutting and associated lines; and he designed the ticket-canceling box now used by the elevated, subway and ferry lines. His first United States patent, issued when he was 19, was for a boiler feed. In 1858 he patented a governor for marine engines to prevent their racing to destruction when the wheels were out of the water.

This was soon after adopted by the U. S. Government and applied to the warships of the period. He had after that patents respectively for gas regulators, for steam pumps, four for steam boilers, five for brick machines, a fluting machine, six for water meters—all these before he had taken up what must now be considered his life work.

Mr. Sergeant was born at Rochester, N. Y., but his early years were spent in Ohio. He received a common-school education and was working in the machine shop at an early age. He soon began to appreciate the possibilities of systematic manufacture by the aid of special machinery and before long had designed special apparatus for the making of the spokes, hubs and felloes of wagon wheels. At the age of 18 he took a contract for manufacturing wheel parts in quantity and two years later he was taken into partnership by a firm manufacturing wagon wheels.

After severing this business connection, the next six years of his life were spent in various pursuits, chiefly commercial, in which he met with varying success. He still found time and opportunity for invention and the development of labor-saving machinery. Three of his brick-machine patents were issued in 1867 when he was a resident of Columbus, Ohio, but soon after that he started a machine shop of his own in New York City, building a wide variety of machines. In the early seventies, with Simon Ingersoll, who brought to the shop the drawings for the first Ingersoll rock drill, a then untried device, he formed the Ingersoll Drill Company and introduced the drill in the rock-excavating fields.

The drill was at first only operated by steam, but its advantages when driven by compressed air and the absolute necessity of using air for mine and tunnel work turned Mr. Sergeant's attention to the improving of the design and details of the air compressor, and he was soon working in both lines, bringing both the drill and the compressor into higher efficiencies. As the business grew, the firm of Sergeant & Cullingworth was formed, with shops at Twenty-second street and Second avenue, New York.

Again turning from manufacturing, Mr. Sergeant sold his interest to the Ingersoll Drill Company and went to Colorado, where for a time he operated a silver mine. Meanwhile he had developed another rock drill with an entirely novel valve motion. He brought his new drill east in 1886 and formed the Sergeant Drill Company, which began building the drill at Bridgeport, Conn. Two years later the new company and the Ingersoll interests joined hands and the Ingersoll-Sergeant Drill Company was formed, with Mr. Sergeant as its first president. The new company's shops, prior to removal to Easton, Penn., were at Ninth avenue and Twenty-seventh street, these shops having been occupied for a short time previously by the firm of Sergeant & Cullingworth, which then went out of existence, Mr. Sergeant's interest in this firm having terminated before he went to Colorado. Mr. Sergeant remained at the head of the company but a short time, then disposing of the bulk of his interest. After spending considerable time in London and Paris he returned to the rock-drill business, this time as a director in the Ingersoll-Sergeant company, and devoted his time to invention in the interest of the company. He spent much of his time at the works in Easton until two years ago, when failing health compelled him to give up his former activities. After the consolidation of the Ingersoll-Sergeant and the Rand companies he still retained his interest, although his health would not permit his active participation. He was a great sufferer from rheumatism, but the immediate cause of his death was paralysis.

Making and Graduating an Arc of Long Radius

BY WALTER GRIBBEN

The piece of sheet brass shown in Fig. 1 is a degree plate for a clock, to be fastened to the clock case underneath the pendulum, and used in setting up and adjusting the clock to determine if each escape takes place at an equal distance from the position occupied by the pendulum when at rest. Another use is to give warning that the clock needs cleaning and oiling, as the arc through which the pendulum swings decreases as the oil gets thick and gummy. In the clock for which this particular plate was made, the escape takes place at 1¼ degrees each side of zero, so when the gentleman who owns the clock finds that the arc has decreased to very near this figure, he knows it is time for him to get up on his step-ladder and oil the pallets, or else send for yours truly.

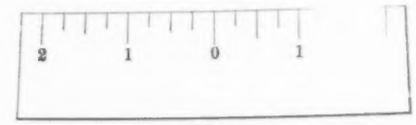


FIG. 1

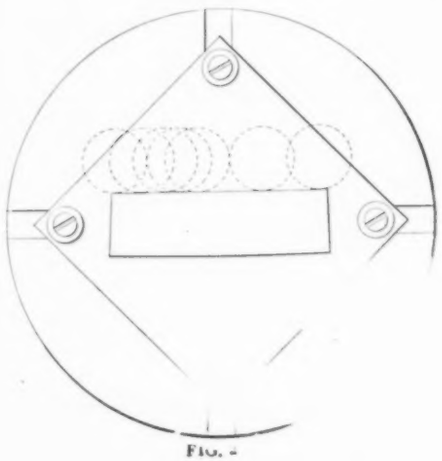


FIG. 2

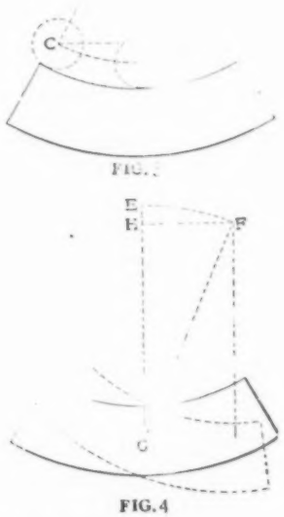


FIG. 4

MAKING AND GRADUATING AN ARC OF LONG RADIUS

A third use for this plate is to form the basis of an article which may be interesting to the readers of the AMERICAN MACHINIST, as I think the principles involved in its construction might also be used to advantage to cut segmental racks having a radius far beyond the capacity of ordinary gear-cutting machines.

Of course, for the purpose for which it was to be used, no great degree of accuracy was called for, as a scale of equal parts was all that was necessary, and, on a pinch, a straight scale might answer just as well as a curved one. But a curved scale looks much better; besides which I was led to do the job this way as a matter of scientific interest, and thought if anyone did spring a segmental rack job on me at any time I would like to be loaded for it, and so got my practice on this little plate.

The radius of the upper edge of the plate was 3 feet 8½ inches, and of the bottom edge, one inch more. The facilities at hand were a bench lathe, with an indexing apparatus on the lathe spindle, and a milling spindle on a vertical slide on the slide rest.

MAKING THE BLANK

The work was soft soldered to a larger brass plate, and the latter clamped to the lathe face plate, as shown in Fig. 2. Then the milling spindle was set parallel with the lathe bed, the lathe spindle locked in position, and a number of cuts made with a fly cutter on the concave edge of the plate by feeding the milling cutter endwise, which gave a series of scallops to act as a guide in filing up the edge of the plate. A few of these milling cuts are shown in Fig. 2 by the dotted circles. As the milling spindle was adjusted to different positions crosswise of the lathe, it had to be lowered and raised a little to produce the slight curve desired.

FIGURING THE ADJUSTMENTS

The method of determining how much to raise or lower the milling spindle is shown in Fig. 3, where the radius of curvature is shortened to show the principle more clearly. In Fig. 4 the radius of curvature is also shortened for the same reason. The radius of the milling cutter is subtracted from the desired radius of curvature, giving the distance *A B*, in Fig. 3. Then if the cross slide is moved a distance equal to *C D*, the vertical slide must be moved an amount equal to *B D*. In this way the rectangular coördinates of the curve were computed for different values of the angle *B A C*, the sines rep-

resenting the cross-slide movement, and the versed sines the vertical-slide movement. Values for *B A C* were selected every five minutes of arc as a convenience in computation, and the versed sines figured out. As the sines of small arcs practically vary as the arcs themselves, the sine of two degrees was computed and then divided by 24. This gave me the position of the milling cutter for 48 cuts along the concave edge of the plate.

The convex edge was done in a similar manner, except that *B D* was longer by one inch plus the diameter of the milling cutter. By using smaller values for *B A C*, thus making more milling cuts, and also using a larger diameter of cutter, the scallops would not be very noticeable, and less filing would have to be done.

After making the cuts for the concave and convex edges, the lathe spindle was indexed around 87¼ degrees either way from its original position, and a milling cut taken over each end of the plate.

GRADUATING THE PLATE

To cut the graduations in the plate it was left as originally clamped, the milling spindle now being placed parallel with the face plate, and a fly cutter with a sharp V point used. The cross feed was used to give the spacing in conjunction with the index apparatus on the lathe spindle, while the vertical slide gave the cut, and the longitudinal slide the feed in for depth.

Fig. 4 shows how the indexing was done. After milling the edges of the plate, the distance of the concave edge from the center line of lathe spindle was determined and added to the 3 feet 8½ inches to find the distance *E G*, in Fig. 4, *E* being the center of curvature of the plate, and *G* the center of the lathe spindle. After making the zero cut in the plate, the lathe spindle was indexed through an angle *E G F*, bringing the center of curvature to *F*. However, before making the cut, the cross slide had to be moved a distance equal to *H F*, which is equal to the sine of the angle *E G F*, multiplied by *E G*. Of course, the center of curvature dropped down a little as the spindle was rotated, so the cut did not always start at the same part of the travel of the vertical slide, but the length of the different lines was gaged by noting the position of the feed-screw handle when the cutter commenced to cut, and then counting the turns, giving six turns for the lines representing whole degrees, five turns for the halves, and three turns for the quarters. Instead of working each way from zero, I began graduating at one end of the plate, and worked right across to the other end, having previously computed and tabulated all the settings for the cross slide.

The location of the work on the face plate in Fig. 2 is not so very important, as it may be anywhere as to hight, as long as the milling spindle can reach it, while the location horizontally is a little better if the ends of the plate are equally distant from the center of the lathe spindle, although this is not absolutely necessary to the success of the job.

Universal Peace and Commerce Exposition

Senator Flint has introduced a bill at Washington for the holding of an exposition (to be known as the Universal Peace and Commerce Exposition) at Los Angeles, California, to commemorate the opening of the Panama canal; and to include exhibits of the arts, industries, manufactures, and products of the soil, mine, and sea. This would be held in 1915, that being the year in which it is anticipated that the Panama canal will be opened.

Apropos of Mr. Osborne's letter at page 709, Vol. 29, Part 2, entitled, "Cannot symbols used in formulas be standardized?" it appears from the following item, taken from *Engineering* (London), that authors and professors, in some quarters at any rate, hold views on this matter similar to those of Mr. Osborne:

The *Zeitschrift für das gesamte Turbinenwesen* contains an article in which Prof. R. Camerer, Munich, sets forth the results so far obtained with reference to the unification of symbols in the designing of turbines. If the same symbols could be generally adopted, it would prove of great convenience, to readers among others, as much time has to be spent in familiarizing one's self with the different symbols used by different authors for expressing the same duties and values.

Personal

Hugo Benzing, specialist on gas engines and gas producers, and who for the past year has been with the Olds Motor Works, has accepted a position as designer on the new type of gas engines with H. L. Wright.

G. A. Rodgers, recently with Ira E. Stevens, representative of the Chandler-Taylor Engine Company, and the Akron Electric Company, has accepted a position with the Fort Wayne Electric Company in its Chicago office.

M. O. Jenkins, formerly connected with the switchboard and steam-turbine work of the General Electric Company, has been appointed assistant electrical engineer for W. S. Barstow & Co., New York and Portland, Ore.

Harry K. Campbell, who for the past two years has been with the Allis-Chalmers Company on Corliss and blowing engines, has accepted a position as chief draftsman with the Weimer Machine Works Company, Lebanon, Penn.

C. T. Alden, formerly chief electrician of the American Locomotive Company, and later with the General Electric Company and the Bath Iron Works, has been placed in charge of the electrical department of W. S. Barstow & Co., New York and Portland, Ore.

Obituary

John L. Purinton, a well known inventor and for the past twenty-six years a resident of Hartford, Conn., died at that place Feb. 4, 88 years old. He was born in Somerset, Mass., and in his early life was a carpenter, later becoming master mechanic at the Greenwoods Company in New Hartford. Among his inventions are a loom, a system of rope transmission, and a process of making pressed nuts.

Norman C. Stiles, a former resident of Middletown, Conn., where he was president of the Stiles & Parker Press Company, died at Hartford, February 4. Mr. Stiles was 72 years old and had been in failing health for about a year. He had been a resident of Hartford for the past five years. He was a member of the A. S. M. E. and was vice-president of that organization from 1885 to 1887.

Harry C. Weber, superintendent of the Weber Gas Engine Company, Kansas City, Mo., died January 21, at Phœnix, Arizona, aged 31 years. He was born at Boonville, Mo. At the age of 18 he began serving his apprenticeship in the machine shop of his father, Geo. J. Weber and at the age of 25 was appointed general superintendent of the Weber plant at Kansas City. For the past several years Mr. Weber had been engaged in field work, supervising large gas engine installations.

Rear Admiral Charles Harding Loring died suddenly of paralysis February 5, at Hackettstown, N. J. He was born in Boston in 1828, and entered the navy in 1851. He served with the North Atlantic Squadron in the Civil War and took part in the battle between the "Monitor" and the "Merrimac." He was appointed engineer in chief of the navy in 1884, and was retired in 1890. He was a member of the Army and Navy Club, and was a former president of the American Society of Mechanical Engineers and of the Engineers' Club of New York City.

William L. Simpson, a well-known consulting engineer, died February 1, of apoplexy at his home, in Philadelphia, Penn. Mr. Simpson was a native of that city, and was 60 years old. He was the founder of the Keystone Engine and Machine Works, which he operated for a number of years at Fifth and Buttonwood streets. Before his marriage he followed the sea for some years as a marine engineer. He was subsequently superintendent of a prominent iron works at Hagerstown, Md. He had been a member of the American Society of Mechanical Engineers since November, 1890.

Business Items

The Buffalo (N. Y.) Forge Company has changed the location of its Cleveland office from 311 Citizens Building to 618 Citizens Building.

The annual convention of the officers and branch managers of the Crocker-Wheeler Company was held at the company's main office and works, Ampere, N. J., January 23 to 26.

Dodge & Day, Philadelphia, are building the new shops of the Jones & Lamson Machine Company at Springfield, Vt. The order for steel has been placed, and the work is being pushed as rapidly as possible.

Robert W. Hunt & Co., Chicago, have been appointed consulting engineers to the receivers of the Union Traction Company, Chicago, and placed in direct charge of the lowering of the car tunnels under the Chicago river.

The new building for the Bridgeport (Conn.) Brass Company, which is being engineered and constructed by Dodge & Day, Philadelphia, is well under way, the steel having been ordered and the foundation work nearly completed.

Contracts have been let by the National-Acme Mfg. Co., Cleveland, O., for the erection of an addition to its present plant. The new building will be of brick and steel construction, approximately 400 ft. long, six stories high, and will be ready for occupancy July 1.

Among large manufacturing plants now being equipped with the Sturtevant system of heating and ventilating are the following: Reeves Pulley Company, Columbus, Ind.; National Tube Company, McKeesport, Penn.; Graton & Knight Manufacturing Company, Worcester, Mass.; and Canadian Pacific Railway Company, Toronto Junction, Ont.

The B. F. Sturtevant Company, of Boston, Mass., has recently received orders for its new type of high pressure rotary blowers from the General Fire Extinguisher Company, Atlanta, Ga.; Rivett Lathe Company, Brighton, Mass.; Wayne Agricultural Works, Goldsboro, N. C.; J. B. Clark Mfg. Company Rockford, Ill.; New York Continental Jewel Filtration Company, New York City; Winchester Repeating Arms Company, New Haven, Conn.; Salem Glass Company, Salem, N. J.; and Eastern Chemical Company, Boston, Mass.

Manufacturers

The Compression Pump Company has been organized at Pueblo, Colo., with a capital of $50,000. W. L. Stone, Joseph Falardeau and E. H. Stone, incorporators.

The Midland Condenser Company, Buffalo, N. Y., will erect a new plant for the manufacture of feed water heaters, surface condensers and steam specialties.

Swift & Company has completed plans for the immense packing plant which it will erect at Portland Ore. When completed the plant will employ 5000 men.

The Rapid Railroad Company, with general offices in Detroit, Mich., is making arrangements for the building of an independent power station at Port Huron, Mich.

The Independent Pneumatic Tool Company, Chicago, Ill., has purchased a building adjoining its plant in which will be installed a large amount of new machinery.

Miscellaneous Wants

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cox Computers, 75 Broad St., New York.

Caliper cat. free. E.G. Smith Co., Columbia, Pa.

Universal Test Indicator circulars free. H. A. Lowe, Lock Box 146, Cleveland, O.

Light, fine machry. to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Dies and Diemaking, $1.00. A shop book by a shop man. J. L. Lucas, Bridgeport, Ct.

We want to hear from parties who desire to make some gasolene engines. Address "M. R.," care AMERICAN MACHINIST.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—Upright drills for sale in Great Britain, France and Italy. Will carry large stock. Apply Box 456, AMERICAN MACHINIST.

Wanted—New or modern second-hand engine lathe about 48 ft. swing, 20 ft. bed. The Hastings Pavement Company, Hastings-on-Hudson, N. Y.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACHINIST.

Wanted—The following second-hand machinery which must be in good condition: one compound marine engine, inverted cylinders, 10 and 24 inches diameter, 16 inches stroke approximate; one direct coupled electric generator about 5 Kw., one circulating engine cylinder 4 or 5 inches diameter; one surface condenser about 600 square feet cooling surface. Box 623, AMERICAN MACHINIST.

Successful draftsmen drawing $125 to $200 monthly require thorough drafting room knowledge. As chief draftsman of engineering firm I know exactly the quality and quantity of experience and practical training you must have, and prepare you by mail, home instructions for above paying positions, which I furnish free anywhere. Complete highest grade drawing outfit, with German silver set of tools, value $13.85, free. Address Chief Draftsman, Div. 4., Eng.'s Equip't Co. (Inc.), Chicago.

Business Opportunities

We have an option on a new 2¼" Cleveland automatic machine for delivery in September, 1907. What is offered for same? Box 622, AMERICAN MACHINIST.

Planers—A recently designed reversing gear for planers which does not involve the reversal of any gear except the rack pinion and the shaft on which it is mounted. Simple and efficient. Patent to be disposed of. Apply for particulars to W. P. Davies, Danielsville, Pa.

We can build machinery for quick delivery. A shop building machine tools wishes to take contracts for the construction of machinery or anything that can be produced in a foundry and machine shop. Send drawings and specifications and estimates will be made with guarantee of quick delivery. We can refer to a standard line of tools now on the market as to the quality of workmanship. Box 75, AMERICAN MACHINIST.

Advertiser who is mechanical salesman and commercial man, desires to meet a first-class up-to-date lathe designer and successful shop manager with $5000 to $10,000 or more to invest with equal amount by advertiser to produce a line of lathes with superior advantages to fully meet up-to-date requirements. Answer in full confidence, stating fully age, experience and all general particulars and we will arrange for personal interview. Box 71, AMERICAN MACHINIST.

For Sale

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—One Reeves speed controller, class G, No. 1, 6¼ to 9 horse-power, excellent condition; price $50. Fels & Company, Philadelphia, Pa.

For Sale—Cyclopedia of modern shop practice, four volumes; bound in green morocco leather. Practically new; cost $18; will sell for $6. Address L. N. O., Box 425, Chicago, Ill.

For Sale—A fully equipped machine shop; buildings erected for the purpose; large ground with railroad siding; will sell the business of engine building with it; immediate possession; location, eastern Pennsylvania. Box 625, AMERICAN MACHINIST.

Wants

Situations and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Young, educated machinist desires position with any first-class machine exhibit at Jamestown. Box 617, AMERICAN MACHINIST.

CONNECTICUT

Wanted—A responsible position by a gun expert (37); twenty years' experience as toolmaker foreman, drafting designer and superintendent on fine and medium interchangeable work; A-1 references by past and present employers; any location. Box 615, AM. MACH.

ILLINOIS

Draftsman — Engineer in charge of large drafting room in the West wants work in the East. Box 546, AMERICAN MACHINIST.

NEW HAMPSHIRE

Position as assistant superintendent, general foreman, or tool room foreman; experienced on light to medium fine work; 12 years in charge of help; age 40. Box 624, AM. M.

NEW JERSEY

Secretary, or assistant to general manager; thorough knowledge modern office and shop systems, selling and purchasing; good, concise correspondent; can take entire charge office, advertising, catalog compilaton, etc.; man of more than ordinary ability, and will consider only first-class position in the East. Send full details and salary to "Secretary," Box 628, AMERICAN MACHINIST.

Sales and office manager; 17 years' experience machinery and manufacturing business; wide experience both sales and purchasing departments; strong executive, able correspondent and systematizer; desires to correspond with or interview manufacturer wishing services first-class man, and who is willing to pay fair compensation for high-grade ability. Location preferred, New York City or vicinity. Address "Results," Box 630, AMERICAN MACHINIST.

Postion wanted by American, aged 34, in responsible capacity, at business end of large manufacturing concern; one which offers real inducements to man who can carry out his own and others' ideas to successful conclusions and render worth-while opinions on important matters; least salary considered for first year, $2,000; has excellent executive ability; seventeen years' experience in manufacturing and machinery business; sales and office manager and business developer; now employed; there are many concerns that need such services; if you do, write today. Address Box 629, AMERICAN MACHINIST.

NEW YORK

A-1 designer wishes to change position; six years' electrical and mechanical experience. Box 634, AMERICAN MACHINIST.

Machine designer—technical education, 8 years' shop and drafting-room experience—desires position. Box 635, AMER. MACH.

Expert in patent drafting and developing desires a few more clients; intricate machinery specialty; A-1 work for A-1 price; secrecy guaranteed. Box 606, AMERICAN MACHINIST.

Position as manager of works; held similar position seven years; can improve and design machinery; good mechanical, executive and business abilities; furnish best of references from concern where now employed. Box 374, AMERICAN MACHINIST.

A first-class mechanical draftsman is open for employment; 17 years' experience on air compressor, Corliss and Meyer valve engines, steam and air driven rock drills and electric drills; first-class references. Address Box 633, AMERICAN MACHINIST.

Experienced iron foundry superintendent, or foreman wishes situation; first-class references, heavy, and light machinery castings, loam, dry green-sand, molding machines; well up in cupola practice, mixing by analysis, producing first-class castings economically; now employed. Address Box 605, AM. MACH.

PENNSYLVANIA

Machine shop foreman desires change; good executive; references. Box 621, AMER. MACH.

Position as superintendent or general foreman; specialty automobiles. Box 610, AM. M.

Designing engineer with sixteen years' experience in engineering office, drawing room and shop; wishes change. Prefer New York or vicinity. Box 627, AMERICAN MACHINIST.

Mechanical draftsman wants position, technical graduate; 3 years' shop experience and 5 years' in drafting room on machine design and general engineering work. Box 632, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser nothing else.

CANADA

Wanted—Four telephone engineers, one fire alarm apparatus engineer, six switchboard draftsmen, six apparatus draftsmen, two tool designers. Box 597, AMERICAN MACHINIST.

CONNECTICUT

Wanted—First-class operator on Jones & Lamson turret lathe; also one first-class all-around machinist. The New Machine Co., Danbury, Conn.

Wanted—One first-class man for hardening carbon and high-speed steel tools; also few first-class toolmakers. The New Departure Mfg. Co., Dept. 19, Bristol, Conn.

Toolmakers wanted — Several first-class toolmakers on jig, fixture and gage work; only first-class men are required; also, several A-1 diemakers for punching, bending and blanking dies, on sheet and brass work; also several all-around, A-1 machinists, for general repair and new work. Apply to The Yale & Towne Mfg. Co., Stamford, Conn.

GEORGIA

Wanted—A first-class toolmaker. Address Deloach Mill Mfg. Co., Atlanta, Ga.

ILLINOIS

Wanted—A first-class man, capable of taking charge of a large job gear shop in Chicago. Must have had experience in the jobbing line, state experience and salary expected. Box 613, AMERICAN MACHINIST.

Wanted—Draftsman to have immediate charge of drafting room, by an established firm making high-grade automatic machines and having extensive enlargements under construction; must be familiar with jigs and fixtures for the production of interchangeable parts, and also must have first-class ability in designing them; in replying please give age, nationality, whether married or single, and salary expected; applicants will facilitate matters by giving a brief but clear account of training and experience, together with references. Box 602, AMERICAN MACHINIST.

INDIANA

Wanted—Ten good lathe men; increasing force; good wages; steady employment. Western Motor Co., Logansport, Ind.

Wanted—Lathe men, tool makers, and machinists. Good wages; steady employment; increasing force. The Western Motor Co., Logansport, Ind.

MASSACHUSETTS

Wanted—A good mechanical draftsman who is thoroughly competent in design of cotton machinery, and well up in machine shop practice of same. Reply fully, giving experience and salary required, to "H. A. M.," AMERICAN MACHINIST.

MEXICO

Wanted—First-class iron molder foreman on heavy and light work; must be a hustler, be able to give results and willing to go to Mexico; finest of climate; salary $150 gold per month to commence. Address: Compania Industrial Mexicana, Box 49, Chihuahua, Mex.

Draftsman with technical education, who has had experience in designing special machine tools for heavy work; state experience and wages expected. Engineering Department, Great Lakes Engineering Works, Detroit, Mich.

MISSOURI

Wanted—First-class adjusters accustomed to adding machine and typewriter work. Universal Adding Machine Co., St. Louis.

NEW HAMPSHIRE

Wanted—A draftsman experienced on machine tools; state experience and wages expected. Address Flather & Co., Inc., Nashua, New Hampshire.

NEW JERSEY

Wanted—Three first-class lathe hands, in New Jersey 12 miles from New York City, steady work to good men. Reply Box 609, AMERICAN MACHINIST.

Screw-machine operators wanted on automatics—Acme, Pratt & Whitney or Spencer; able to set up jobs; steady work; highest wages. Mack Mfg. Co., 401 St. Paul's avenue, Jersey City, N. J.

Wanted—Tool, die and instrument makers accustomed to accurate, complicated work; steady work and good wages to thoroughly competent men; give references. Address Box 438, AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

Wanted—Foreman for foundry, open shop employing about 15 men, making machinery castings up to two tons; permanent position to reliable and capable man; state references, age and salary wanted. Address Box 616, AMERICAN MACHINIST.

As we are continually adding to our departments, we have openings for men familiar with engines and pumping machinery; we require lathe, planer, shaper, drill and vise hands, also erectors for inside and outside work; good pay and steady work to good men. Address communications to Henry R. Worthington, Harrison, N. J.

NEW YORK

Wanted—Experienced draftsmen, toolmakers and machinists; give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Wanted—Young man experienced in shop tools and supplies for inside salesman. Address with full particulars. P. O. Drawer, 964, Buffalo, N. Y.

Wanted—Detail draftsmen and tracers on work similar to construction work; state age, salary and experience. Address Box 574, AMERICAN MACHINIST.

Wanted—Draftsman experienced in designing automatic machinery; permanent position assured if satisfactory. Write Room 64, 45 Broadway, New York.

Draftsman on steam pumps in New York City; state experience, references, and pay expected. Address Cameron, 433 E. 23d street, New York City.

Three careful draftsmen wanted to act as checkers on dimensions; previous experience in our line not absolutely essential; salary $21 to $24. Address Box 573, AMER. MACH.

A number of first-class lathe, planer, slotter and boring-mill hands for both day and night shift; good pay and steady work to good men. The Snow Steam Pump Works, Buffalo, N. Y.

Wanted—First-class diemakers on small and medium blanking, forming, and drawing dies for tin boxes; and general sheet metal work. Steady employment to first-class men. Burdick & Son, Albany, N. Y.

Wanted—First-class draftsman, familiar with designing of machinery, preferably one having some experience in valve business. State age, experience in detail and salary expected. Box 637, AMERICAN MACHINIST

Wanted—Office manager in mechanical engineering office; technical graduate preferred but not essential; applicant must have good address and have had several years' experience in meeting people, in handling correspondence, and be methodical in habits. State salary expected. Box 626, AMER. MACH.

Wanted—A man for subordinate engineering position who will be given opportunity to demonstrate within a reasonable time his ability to fill position of master mechanic in a metal working plant employing 1200 hands, located in Central New York; must understand upkeep and improvement of buildings, heating, power, lighting, transmission equipment, etc. Give full details, experience and salary expected. Box 636, AMER. MACHINIST.

Wanted—An expert diemaker who has had wide experience in all kinds of punch and die work and also in general toolmaking to act as instructor in toolmaking and machine construction in large technical school in the East. Ability to impart information to others, executive ability, and experience in handling men as foreman required; age 30 to 40 years; salary $1400, or possibly more to the right man, with good opportunity for advancement. Apply, stating age and experience in detail, to Box 620, AMERICAN MACHINIST.

OHIO

Wanted—First-class draftsman for jigs and tools. Box 614, AMERICAN MACHINIST.

A working foreman wanted for a brass foundry on locomotive work. Address Box 619, AMERICAN MACHINIST.

Wanted—Detailers and designers on heavy machine tool work. Address Niles Tool Works Co., Hamilton, Ohio.

Blacksmiths wanted on locomotive, steady employment and no labor trouble. Address Box 618, AMERICAN MACHINIST.

Wanted—First-class structural engineer capable of designing steel buildings, bridges, etc.; state age, qualifications, initial salary expected, etc. Address 567, AMER. MACH.

Machinists—Lathe and floor hands for strictly first-class machine tool work; steady employment; new enlarged works just completed. The Warner & Swasey Co., Cleveland, Ohio.

Screw machine operator; competent to look after 10 Brown & Sharpe No. 0 automatic cutting-off machines on duplicate work; state experience, reference and salary expected. The Cleveland Twist Drill Co., Cleveland, O.

PENNSYLVANIA

Wanted—First-class floor hands and fitters for machine-tool work. Colburn Machine Tool Company, Franklin, Pa.

Wanted—Mechanical draftsman to design automatic machines. Reply stating age, experience and salary expected, to Box 631, AMERICAN MACHINIST.

Wanted—First-class draftsman on machinery for iron pipe fittings; state age and experience. Address, The Kelly & Jones Company, Greensburg, Penn.

Wanted—Good model worker, used to making parts from sheet metal, such as typewriter and adding machine parts. Address Adder Machine Co., Wilkes-Barre, Pa.

Draftsmen wanted—Experienced draftsmen in electrical apparatus, switchboards, transformers, motors and generators; only first-class men need apply; state experience and salary expected. Address Chief Draftsman, Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

RHODE ISLAND

Toolmakers wanted—First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Peirce Mfg. Co., Woonsocket, R. I.

TENNESSEE

Wanted—Two mechanical draftsmen; previous experience in blast furnace and general steel or smelting plants necessary; applicants must state education and experience in detail, with reference, and salary expected. Address Box 601, AMERICAN MACHINIST.

VERMONT

Wanted—Foreman for erecting department in shop building machine tools; state experience and give references; good opening for the right man. Box 638, AMER. MACHINIST.

WISCONSIN

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reasons for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

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Pike Mfg. Co., Pike, N. H.
Safety Emery Wheel Co., Springfield, O.
Superior Corundum Wheel Co., Waltham, Mass.

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Vitrified Wheel Co., Westfield, Mass.

Aftercoolers, Air

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Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
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Wilmarth & Morman Co., Grand Rapids, Mich.

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Bending Machines, Hydraulic
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American Road Machine Co., Kennett Square, Pa.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bethlehem Foundry & Mach. Co., South Bethlehem, Pa.
Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Bending Tools, Hand
American Road Machine Co., Kennett Square, Pa.
Wallace Supply Co., Chicago, Ill.

Blanks, Nut and Screw
Dyson & Sons, Jos., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Blocks, Chain
See Hoists, Hand.

Blowers
American Blower Co., Detroit, Mich.
American Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Blowers—*Continued.*
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines
General Electric Co., New York.
Soltmann, E. G., New York.

Boilers
Struthers-Wells Co., Warren, Pa.

Bolt and Nut Machinery
Acme Machry. Co., Cleveland, O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Brown & Co., H. B., East Hampton, Conn.
Davis Machine Co., W. P., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Foote-Burt Co., Cleveland, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Landis Machine Co., Waynesboro, Pa.
Northern Elec. Mfg. Co., Madison, Wis.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Machinery Co., Bowling Green, Ohio.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolt Heads
Lang Co., G. R., Meadville, Pa

Bolts, Coupling
National-Acme Mfg. Co., Cleveland, O.

Bolts and Nuts
Dyson & Sons, Jos., Cleveland, O
National-Acme Mfg. Co., Cleveland, O.

Books, Mechanical
American School of Correspondence, Chicago, Ill.
Derry-Collard Co., New York.
Henley Pub. Co., N. W., New York.
Hill Publishing Co., New York.
Piers, Frank, Phila., Pa.
Sames, C. M., Jersey City, N. J.
Wiley & Sons, Jno., New York.

Boosters
Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, Ohio.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Boring and Drilling Machines, Horizontal—*Cont.*
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Carr Bros., Syracuse, N. Y.
Fairbanks Co., Springfield, Ohio.

Brackets, Lamp
Standard Welding Co., Cleveland, Ohio.

Brakes, Magnetic Friction
Electric Controller & Supply Co., Cleveland, O.

Broaching Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Lapointe Mach. Tool Co., Hudson, Mass.

Bulldozers
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Prentiss Tool & Supply Co., New York.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.

Calipers
Athol Mach. Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams
Bilgram, Hugo, Phila., Pa.
Boston Gear Works, Norfolk Downs, Mass.

Carborundum
See Grinding Wheels

Carriers
Lamson Consolidated S. S. Co., Boston, Mass.

Castings, Brass and Bronze
Lumen Bearing Co., Buffalo, N. Y.

Castings, Die Molded
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fairbanks Co., Springfield, O.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Hopson & Chapin Mfg. Co., New London, Conn.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Phœnix Mfg. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines
American Tool Wks. Co., Cin., O.
Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, Ohio.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Oneida Natl. Chuck Co., Oneida, N. Y.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Wells Bros. Co., Greenfield, Mass.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Conn.
Davis Machine Co., W. P., Rochester, N. Y.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Oneida Natl. Chuck Co., Oneida, N. Y.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer

Niles-Bement-Pond Co., New York.
Oneida Natl. Chuck Co., Oneida, N. Y.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split

Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers

Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps

Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Le Count, Wm. G., So. Norwalk, Conn.
Tudor Mfg. Co., Worcester, Mass.

Clutches, Friction

Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons Co., T. B., Chambersburg, Pa.

Clutches, Magnetic

Electric Controller & Supply Co., Cleveland, Ohio.

Coal Handling Machinery

Link-Belt Co., Philadelphia, Pa.

Coils

Standard Welding Co., Cleveland, Ohio.

Collectors, Pneumatic

Sturtevant Co., B. F., Boston, Mass.

Compound, Pipe Joint

Dixon Crucible Co., Joseph, Jersey City, N. J.

Compressors, Air

Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas

Ingersoll-Rand Co., New York.

Conduit, Interior

Sprague Electric Co., New York.

Cones, Friction

Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps

Leard, Wm. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work

Blanchard Mach. Co., Boston, Mass.
Chapman & Co., J. B., Springfield, Mass.
Skinner Ship Bldg. & Dry Dock Co., Baltimore, Md.
Turner Mach. Co., Danbury, Conn.

Controllers and Starters, Electric Motor

Case Mfg. Co., Columbus, O.
Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveying Machinery, Auto

Lamson Consol. S. S. Co., Boston, Mass.

Coping Machines

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Cork Inserts

National Brake & Clutch Co., Boston, Mass.

Corundum

See Grinding Wheels.

Cost Systems

American Mechanical Calculator Co., Cincinnati, O.

Cotters

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counters, Machinery

Veeder Mfg. Co., Hartford, Conn.

Counterbores

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.

Countershafts

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Mossberg Wrench Co., Central Falls, R. I.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction

Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing

Cresson Co., Geo. V., Phila., Pa.
Evans Friction Cone Co., Newton Centre, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose

Ingersoll-Rand Co., New York.

Couplings, Shaft

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cresson Co., Geo. V., Phila., Pa.
Electric Controller & Supply Co., Cleveland, Ohio.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

Cranes

Alliance Machine Co., Alliance, O.
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nichols, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.

Cranes—*Continued.*

Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines

Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts

Leard, Wm. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles

Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers

Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry

Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil

Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Cups and Covers, Oil

Williams Valve Co., D. T., Cincinnati, O.
Winkley Co., Detroit, Mich.

Cups, Grease

Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.

Cutters, Milling

Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Nash Company, Geo., New York.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines

Armstrong Bros. Tool Co., Chicago, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-Off Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fairbanks Co., Springfield, Ohio.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers

Veeder Mfg. Co., Hartford, Conn.

Diamond Tools

Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Dies, Sheet Metal

American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Boston Tool Co., Cambridge, Mass.
Kent & Co., Edw. R., Chicago, Ill.
Wade Machine Co., Boston, Mass.

Dies, Sub-Press

Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening

Boker & Co., Hermann, New York.
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mach. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins

Winkley Co., Hartford, Conn.

Drawing Boards and Tables

Alteneder & Son, Theo., Philadelphia, Pa.
Economy Drawing Table Co., Toledo, Ohio.
Queen & Co., Philadelphia, Pa.
Soltmann, E. G., New York.

Drawing Materials

Alteneder & Son, Theo., Philadelphia, Pa.
American Tracing Cloth Co., New York.
Derry-Collard Co., New York.
Mittineague Paper Co., Mittineague, Mass.
Queen & Co., Philadelphia, Pa.
Soltmann, E. G., New York.
Technical Supply Co., Scranton, Pa.

Drafting Machines

Universal Drafting Mach. Co., Cleveland, O.

Drift Bolt Drivers

Ingersoll-Rand Co., New York.

Drilling Machines, Bench

Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Dwight Slate Mach. Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Boiler

American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote, Burt Co., The, Cleveland, Ohio.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Multiple Spindle

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Fenn Mach. Co., Hartford, Conn.
Foote, Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Harrington Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.

"Whitney" Chains

In 1907 will break all previous records for durability

We are moving into our new fire-proof factory building and will operate both plants, old and new, until we are fully settled so our production may be steadily increased with no interruption.

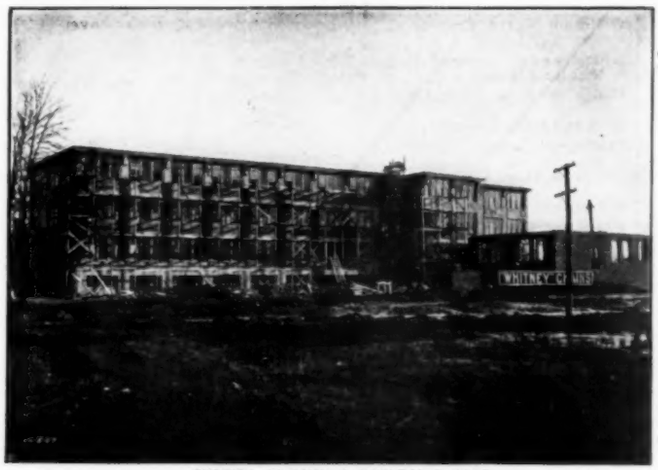
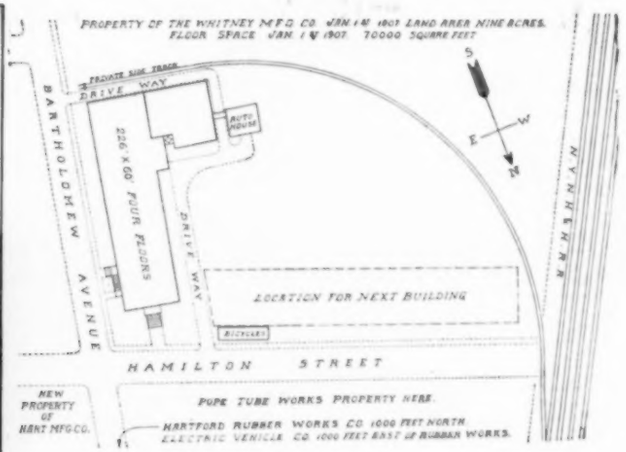


PHOTO. TAKEN JANUARY 6, 1907



This cut gives an idea only of the plant which we believe will be the finest and most complete in existence for the manufacture of High Grade Driving Chains.

"Whitney" Chains

HAND AND WEIGHT FEED MILLING MACHINES, and The Woodruff Patent System of Keying

are Standard with most American Builders of Automobiles, Commercial Cars, Machinery, etc.

The Whitney Mfg. Co.

Hartford Connecticut

Drilling Machines, Multiple Spindle —*Continued.*
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.

Drilling Machines, Portable
Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Fenn Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford,
Slocomb Co., J. T., Prov., R. I. Conn.
Standard Tool Co., Cleveland, O.

Drills, Hand
Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drills, Pneumatic
Chisholm & Moore Mfg. Co., Cleveland, O.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Foote-Burt Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Boker & Co., Hermann, New York.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Keystone Mfg. Co., Buffalo, N. Y.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drying Apparatus
American Blower Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos
Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Crescent Forgings Co., Oakmont, Pa.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.
U. S. Electrical Tool Co., Cincinnati, O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Wrigley Co., Thos., Chicago, Ill.

Enclosures, Tool-room
Hart & Cooley Co., New Britain, Conn.
Merritt & Co., Philadelphia, Pa.

Engineering Appliances
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.

Engineers, Consulting and Mechanical
Dodge & Day, Philadelphia, Pa.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.
Dodge & Day, Phila., Pa.

Engines, Automobile
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Olds Gas Power Co., Lansing, Mich.

Engines, Gas and Gasolene
Automatic Mach. Co., Bridgeport, Conn.
Blaisdell Machinery Co., Bradford, Pa.
Foos Gas Engine Co., Springfield, Ohio.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Era Gas Engine Co., Dayton, O.
Olds Gas Power Co., Lansing, Mich.
St. Marys Mach. Co., St. Marys, Ohio.
Struthers-Wells Co., Warren, Pa.

Engines, Steam
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engravers
Bormay Engraving Co., New York.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition Machinery
Machinery Exchange, Boston, Mass.
Philadelphia Bourse, Phila., Pa.

Expanders, Boiler Tube
Nicholson & Co., Wm., Wilkes-Barre, Pa.

Fans, Electric
Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Feathers
Standard Gauge Steel Co., Beaver Falls, Pa.

Files and Rasps
American Swiss File & Tool Co., New York.
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichheim & Co., E. P., New York.

Filler, Iron
Felton, Sibley & Co., Phila., Pa.

Filing Machines
Cochrane-Bly Co., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Henry & Wright Mfg. Co., Hartford, Conn.
Simplex Mfg. Co., New York.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Rand Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
O. K. Tool Holder Co., Shelton, Conn.
Page-Storms Drop Forge Co., Springfield, Mass.
Wyman & Gordon Co., Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon Co., Worcester, Mass.

Forgings, Machine
Dyson & Sons, Jos., Cleveland, O.

Forgings, Steel
Baldwin Steel Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon Co., Worcester, Mass.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila, Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers
Sturtevant Co., B. F., Hyde Park, Mass

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Nash Company, Geo., New York.
Tate, Jones & Co., Pittsburg, Pa.

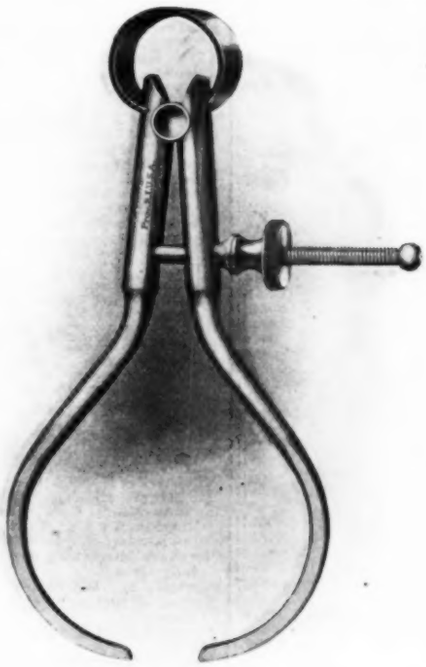
Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Nash Company, Geo., New York.
Obermayer Co., S., Cincinnati, O.
Westmacott, J. M., Prov., R. I.

Furnaces, Melting
American Gas Furnace Co., New York.
Nash Company, Geo., New York.
Turner Brass Works, Chicago, Ill.

Furnaces, Oil
Tate, Jones & Co., Pittsburg, Pa.

Furniture, Machine Shop
Hart & Cooley Co., New Britain, Conn.
Manufacturing Equip. & Engineering Co., E. Boston, Mass.



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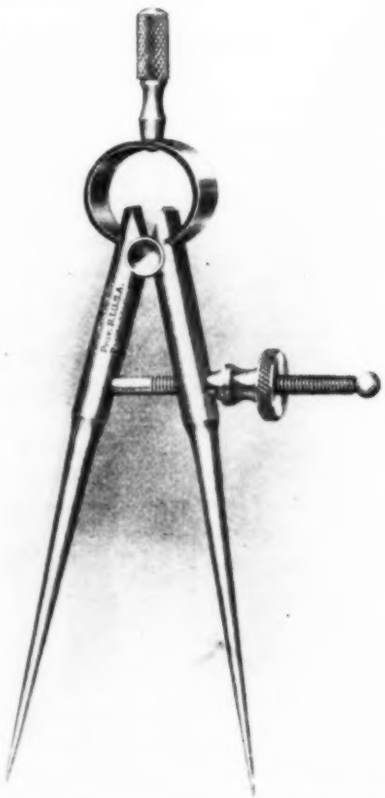

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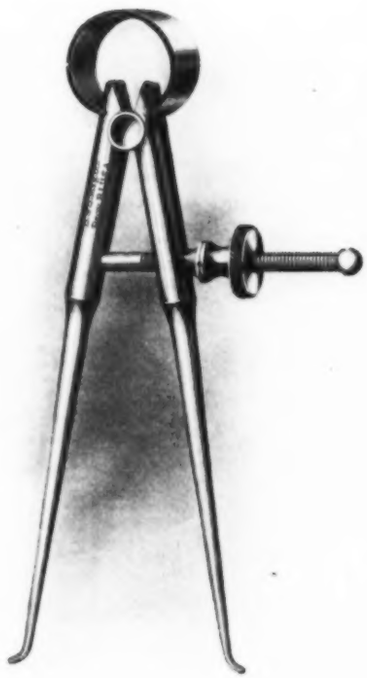

Furniture, Machine Shop —*Continued.*
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Hyde Park, Mass.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bilgram, Hugo, Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Sons & Co., Edwin, Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Walcott & Son, Geo. D., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mach. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Wks., Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Morse, Williams & Co., Phila., Pa.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O
Simonds Mfg. Co., Pittsburg, Pa
Spacke Mach. Co., F. W., Indianapolis, Ind.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O

Gears, Cut—*Continued.*
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Greenwald Co., I. & E., Cin., O.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Rawhide
Boston Gear Works, Norfolk Downs, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, O.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Works, Cleveland, O.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Norfolk Downs, Mass.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Morse, Williams & Co., Phila., Pa.
Nuttall Co. R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Generating Sets
Burke Electric Co., Erie, Pa.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas
American Gas Furnace Co., New York.

Gibs
Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cin., O.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Bath Grinder Co., Fitchburg, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Co., Worcester, Mass.

Grinders, Cutter—*Continued.*
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Cylindrical
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk
Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov., R. I.
Gardner Machine Co., Beloit, Wis.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.

Grinders, Drill
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinders, Piston Ring
Heald Mach. Co., Worcester, Mass.

Grinders, Portable
Cincinnati Electrical Tool Co., Cincinnati, O.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
U. S. Electrical Tool Co., Cin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
U. S. Electrical Tool Co., Cincinnati, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.
Wilmarth & Morman Co., Grand Rapids, Mich.

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Abrasive Material Co., Philadelphia, Pa.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diamond Mach. Co., Prov., R. I.
Goodell-Pratt Co., Greenfield, Mass.
Graham Mfg. Co., Prov., R. I.
Greenfield Mach. Co., Greenfield, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Machry. Co., Chicago, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Norton Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Wells Sons Co., F. E., Greenfield, Mass.

Grinding Wheels
Adams Co., Dubuque, Iowa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Cortland Cor. Wheel Co., Cortland, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Corundum Wheel Co., Brightwood, Mass.
Niles-Bement-Pond Co., New York.
Norton Co., Worcester, Mass.
Pike Mfg. Co., Pike, N. H.
Safety Emery Wheel Co., Springfield, O.
Superior Corundum Wheel Co., Waltham, Mass.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.
Worcester Emery Wheel Co., Worcester, Mass.

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Niles-Bement-Pond Co., New York.
Pike Mfg. Co., Pike, N. H.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

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Chisholm & Moore Mfg. Co., Cleveland, O.
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Prentiss Tool & Supply Co., New York.
Scranton & Co., New Haven, Ct.

Hammers, Steam

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Crescent Forgings Co., Oakmont, Pa.
Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Handles, Machine Tool

Cincinnati Ball Crank Co., Cincinnati, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Hangers, Shafting

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Link-Belt Co., Philadelphia, Pa.
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Sturtevant Co., B. F., Hyde Park, Mass.

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Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

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Chicago Flexible Shaft Co., Chicago, Ill.

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American Road Mach. Co., Kennett Square, Pa.
Brown Hoisting Machinery Co., Cleveland, O.
Case Mfg. Co., Columbus, O.
Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Jeffrey Mfg. Co., Columbus, O.
Lamson Consolidated S. S. Co., Boston, Mass.
Link-Belt Co., Philadelphia, Pa.
Main Belting Co., Phila., Pa.
Niles-Bement-Pond Co., New York.
Sturtevant Co., B. F., Boston, Mass.
United Engineering & Fdry. Co., Pittsburg, Pa.

Hoists, Electric

C & C Electric Co., New York.
Case Mfg. Co., Columbus, Ohio.
Cleveland Crane & Car Co., Wickliffe, O.
Crocker-Wheeler Co., Ampere, N. J.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Electric Co., New York.
General Pneumatic Tool Co., Montour Falls, N. Y.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand

Case Mfg. Co., Columbus, O.
Chisholm & Moore Mfg. Co., Cleveland, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Moore Co., Franklin, Winsted, Ct.
Nichols, Wm. S., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic

Chisholm & Moore Mfg. Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Northern Engineering Works, Detroit, Mich.

Hones

Pike Mfg. Co., Pike, N. H.

Hose

Rhoads & Son, J. E., Phila., Pa.
Sprague Electric Co., New York.

Hot Blast Apparatus

Sturtevant Co., B. F., Boston, Mass.

Igniters, Gas Engine

Franklin Mfg. Co., H. H., Syracuse, N. Y

Indicators, Speed

Hebert Co., J. R., Brooklyn, N. Y.
Niagara Tachometer & Inst. Co., Niagara Falls, N. Y.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral

Warner Instrument Co., Beloit, Wis.

Indicators, Steam Engine

Crosby Steam Gage & Valve Co., Boston, Mass.

Indicators, Test

Indicator Co., La Porte, Ind.
Lowe, H. A., Cleveland, O.
Norton Co., Worcester, Mass.

Industrial Railways

Hunt Co., C. W., West New Brighton, N. Y.

Injectors

International Specialty Co., Detroit, Mich.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Williams Valve Co., D. T., Cincinnati, O.

Inspection and Tests

Hunt Co., Robert W., Chicago, Ill.

Instruments, Electric

General Electric Co., New York.

Jacks, Hydraulic

Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Joyce-Cridland Co., Dayton, O.
Watson-Stillman Co., New York.

Jacks, Planer

Armstrong Bros. Tool Co., Chicago, Ill.

Kettles, Soda

Brown & Sharpe Mfg. Co., Providence, R. I.
Mfg. Equip. & Eng. Co., E. Boston, Mass.

Key Seaters

Baker Bros., Toledo, O.
Chattanooga Machinery Co., Chattanooga, Tenn.
Lapointe Mach. Tool Co., Hudson, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knives, Machine

Coes Wrench Co., Worcester, Mass.

Knurls

Hammacher, Schlemmer & Co., New York.

Lamps, Arc

General Electric Co., New York.
Turner Brass Works, Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Lathe Attachments

American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John Dundas, Ontario, Canada.
Bradford Machine Tool Co., Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Sloan & Chace Mfg. Co., Newark, N. J.

Lathe Dogs

Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
LeCount, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes

American Tool & Machine Co. Boston, Mass.
American Tool Wks. Co., Cin., O.
Automatic Mach. Co., Bridgeport, Conn.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John. Dundas, Ontario, Canada.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O
Bullard Mach. Tool Co., Bridgeport, Conn.
Champion Tool Works Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Diamond Mach. Co., Prov., R. I.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., Springfield, O.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gisholt Mach. Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co. Torrington, Conn.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Machry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rahn-Carpenter Co., Cincinnati, Ohio.
Schumacher & Boye, Cincinnati, Ohio.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Springfield Mach. Tool Co., Springfield, O.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Walcott & Son Co., Geo. D., Jackson, Mich.
Wells Sons Co., F. E., Greenfield, Mass.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Lathes, Automatic Screw-Threading

Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Lathes, Bench

Blount Co., J. G., Everett, Mass.
Fenn Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark Tool Co., Waltham, Mass.

Lathes, Bench—*Continued.*

Sloan & Chace Mfg. Co., Newark, N. J.
Waltham Machine Works, Springfield, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canda.
Harrington, Son & Co., Edwin, Philadelphia Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Lathes, Brass

Bardons & Oliver, Cleveland, O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Dreses Mach. Tool Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Lathes, Extension

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Prentiss Tool & Supply Co., New York.

Lathes, Foot Power

Barnes Co., W. F. & Jno., Rockford, Ill.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Lathes, Speed

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Blount Co., J. G., Everett, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Lathes, Wood

Prentiss Tool & Supply Co., New York.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Towsley Mfg. Co., John T., Cincinnati, O.

Letters, Pattern

Butler, A. G., New York.

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Starrett Co., L. S., Athol, Mass.

Lifting Magnetics

Electric Controller & Supply Co., Cleveland, O.

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Hart & Cooley Co., New Britain, Conn.
Merritt & Co., Philadelphia, Pa.

Locks

Yale & Towne Mfg. Co., New York.

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General Electric Co., New York.

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Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators

Besly & Co., Chas. H., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Williams Valve Co., D. T., Cincinnati, O.

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Chandler & Farquhar, Boston, Mass.
Garvin Mach. Co., New York.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Motch & Merryweather Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Vandyck Churchill Co., New York.

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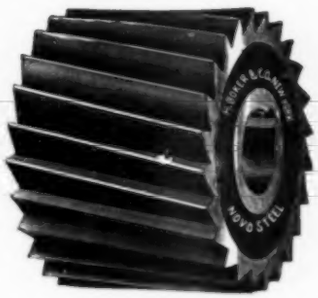
We Carry a Complete Stock.

All NOVO Milling Cutters are furnished by us subject to trial and approval, and are absolutely guaranteed.



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Hermann Boker & Co.

SMALL TOOL DEPARTMENT,

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From Here To Here

which is the business section of a Hack Saw, there should be a just-right degree of hardness —so precise that a trifle more would make it brittle and a little less would make it too soft.

Victor Hack Saws Are Of Perfect Temper

between these points—outside of which they are soft. We secure this perfect temper by the Victor tempering process. That's one reason "Victor's" are victorious—cutting cleanest, most accurately and fastest—in all competitive tests. Another is that the teeth are milled and shear set. Ask for more. Send for free samples and test them yourself—state the stock you want to cut and length of frame.

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Whitman & Barnes Mfg. Co., Chicago, Ill.

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Le Count, Wm. G., So. Norwalk, Conn.
Nicholson & Co., W. H., Wilkes-Barre, Pa.

Mandrels, Solid

Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Schellenbach & Darling Tool Co., Cincinnati, O.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

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Slate Machine Co., Dwight, Hartford, Conn.

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Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.

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Sturtevant Co., B. F., Hyde Park, Mass.

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Besly & Co., Chas. H., Chicago, Ill.
Lumen Bearing Co., Buffalo, N. Y.

Meters, Cut

Warner Instrument Co., Beloit, Wis.

Meters, Electric

General Electric Co., New York.

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Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
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Niles-Bement-Pond Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

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Rivett Lathe Mfg. Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Hand

Brown & Sharpe Mfg. Co., Providence, R. I.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct

Milling Machines, Horizontal

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Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Cincinnati Milling Machine Co., Cincinnati, O.
Hendey Mach. Co., Torrington, Ct.
Hess-Bright Mfg. Co., Phila., Pa.
Ingersoll Milling Mach. Co., Rockford, Ill.
Kempsmith Mfg. Co., Milwaukee, Wis.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Milling Machines, Plain

Adams Co., Dubuque, Iowa.
American Tool Wks. Co., Cin., O.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Conn.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitney Mfg. Co., Hartford, Ct.

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Underwood & Co., H. B., Philadelphia, Pa.

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Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Conn.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Machry. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical

Adams Co., Dubuque, Iowa.
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Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough R. M., Tolland, Conn.
Garvin Mach. Co., New York.
Ingersoll Milling Mach. Co., Rockford, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Milling Machines, Vertical—*Continued.*

Owen Mach. Tool Co., Springfield, O.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Milling Tools, Adjustable

Geometric Tool Co., New Haven, Conn.
Rogers Works, John M., Gloucester City, N. J.

Mining Machinery

Ingersoll-Rand Co., New York.

Mixing and Sifting Machines

Gould & Eberhardt, Newark, N. J.
Link-Belt Co., Philadelphia, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Molding Machines

Adams Co., Dubuque, Iowa.
Mumford & Co., E. H., Phila., Pa.
Tabor Mfg. Co., Phila., Pa.

Mortising Machines, Chain

New Britain Mach. Co., New Britain, Conn.

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Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Electrical Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Name Plates

Franklin Mfg. Co., H. H., Syracuse, N. Y.
Turner Brass Works, Chicago, Ill.

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Lunkenheimer Co., Cincinnati, O.

Nut Tappers

See Bolt and Nut Machinery.

Oil Stones

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Pike Mfg. Co., Pike, N. H.

Packings, Hydraulic

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Packing, Steam

Jenkins Bros., New York.

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Felton, Sibley & Co., Phila., Pa.

Pans, Lathe

New Britain Mach. Co., New Britain, Conn.

Pans, Shop

Kilbourne & Jacobs Mfg. Co., Columbus, Ohio.
New Britain Mach. Co., New Britain, Conn.

Patents

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Prentiss Tool & Supply Co., New York.
Saunders Sons, D., Yonkers, N. Y.
Standard Engineering Works, Ellwood City, Pa.
Stoever Fdry. & Mfg. Co., Myerstown, Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Pipe Fitters' Tools

Cleveland Twist Drill Co., Cleveland, O.
Saunders Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer Attachments

Cincinnati Planer Co., Cincin., O.
Gray Co., G. A., Cincinnati, O.

Planer Tools

Armstrong Bros. Tool Co., Chicago, Ill.
O. K. Tool Holder Co., Shelton, Conn.

Planers

American Tool Wks. Co., Cin., O.
Bartlett, E. E., Boston, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co. Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Cleveland Planer Works, Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Conn.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
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Sellers & Co., Inc., Wm., Philadelphia, Pa.
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THE HYDRAULIC COMPRESSED-AIR POWER PLANT AT THE VICTORIA MINE

Pressure Secured Without Moving Machinery—Cost and Efficiency

BY D. E. WOODBRIDGE

The clever adaptation of an old method of air compression in successful operation at the Victoria mine and mill, Ontonagon county, Mich., is now running every power consumer around the property. More than 82 per cent. of the actual power of the water is transferred to compressed air under a pressure of 117 pounds, without the aid of any moving machinery, delivered to the air main dry and at the temperature of the water. As the installation of this compressor, including all expenditures, cost less than $22 per horse-power, and the construction of the dam and canal with all accessory expenditures was about the same, the cost of this power averages about $2.25 per horse-power year, allowing 5 per cent. interest on first costs. It is practically automatic and, as there are no moving parts, it is a most durable installation. The plant was designed and built by C. H. Taylor, of Montreal, under a guarantee to develop over 4000 horse-power with an efficiency of 70 per cent.

VIEW OF THE DAM, A PORTION OF THE CANAL, THE COMPRESSOR HOUSE AND THE BLOW-OFF

DETAILS OF CONSTRUCTION

Water is taken from the Ontonagon river and is returned to it a mile farther down stream, after the benefit of a net fall of 71 feet has been secured. A concrete dam 300 feet long and 10 feet high was built across the river, and from this a sufficient flow for the works was diverted to a canal that conveys the water needed a distance of 4000 feet down stream. This canal has a sectional area of 350 square feet. There is a net drop of 71 feet to the level of the river. At the foot of the canal three vertical, circular and smoothly cemented shafts were sunk 330 feet, each being 5 feet in diameter, and ending in the roof of a large chamber. Down into this chamber project conical steel tubes. They continue the shafts 16 feet and flare to a diameter of 7 feet 4 inches at the base, set above concrete spreading piers built upon the chamber floor. The concrete bottoms of the rock shafts, the conical spreading piers and the steel tubes between are shown in the illustrations.

The chamber into which the water from the canal falls is at this point 57 feet wide by 22 feet high, and carries these dimensions for 50 feet and then narrows to a width of 18 feet and a hight to the center of its arched roof of 25 feet and so continues till it has reached a total length of 282 feet. Here the chamber becomes a tunnel with a hight of 10 feet and continues as such for 40 feet, where an incline shaft to the surface carries the water to the river. Compression takes place in this large underground chamber, excavated in rock. From the level of the forebay to the top of the water in the air chamber is 342 feet; the water-power head from the forebay to the tail-water line is 71 feet and the air-pressure head therefore is 271 feet. The air capacity of the underground chamber, between its water line and roof, is 80,264 cubic feet.

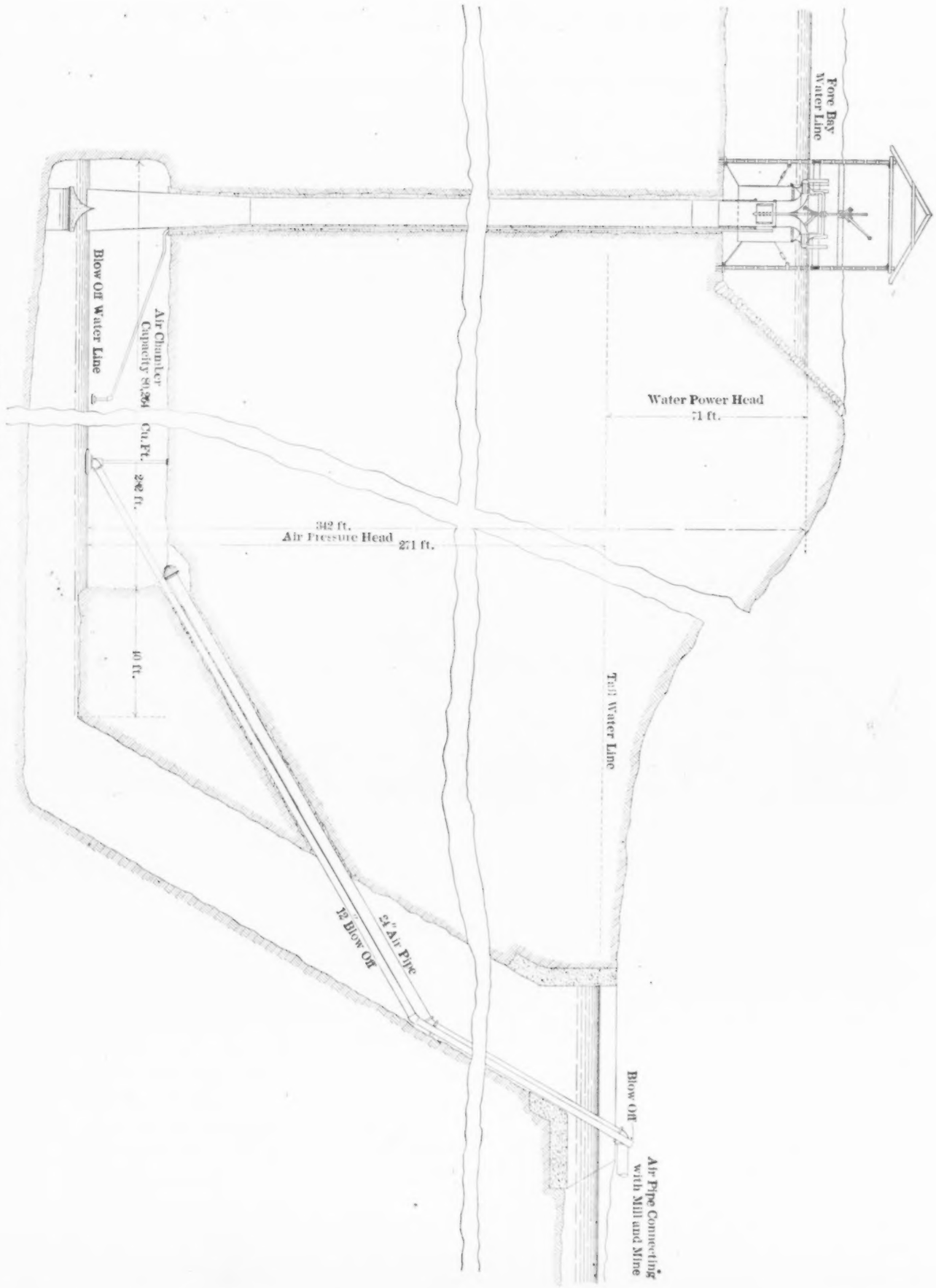
A tunnel at 30 degrees incline was run from the upper end of the chamber to the surface, carrying the air main which conveys the power to the mine and the mill, and also a 12-inch blow-off. The space in this tunnel not occupied by these pipes is solidly filled with concrete. The blow-off, or escape pipe, opens at the water level in the chamber 12 feet below its roof and terminates with an open end 5 feet above the tail-race level. Its purpose is that of a governor.

PRINCIPLES OF OPERATION

On the bottom of the forebay are the upper ends of the three cylindrical shafts, each in a steel tube rising 6 feet above the base of the forebay. In this and forming its upper movable end, is telescoped an additional length which moves freely up and down so that it may be in any depth of water or may be so high that no water can flow over it, thus shutting off the operation of the plant. Above this is an annular pipe, or header, which is designed to be below water level when the plant is in operation.

This header has an average diameter of 10 inches, and is directly connected with two sets of tubes, one of which is composed of eight 7-inch verticals, the upper ends of which project above water line, and which are the atmospheric intakes. There are eighteen hundred ⅜-inch tubes projecting inward horizontally from the header. Over these, water flows downward and by its suction draws air down the atmospheric intakes, through the small tubes, and into the column of water descending the main shaft to the compression chamber.

The space between the concave and convex cylindrical castings, shown in the drawing of the headpiece, is adjusted by dropping the concave casting down a lifting screw, which is also shown. In the hub of the spider supporting this casting is set a fixed nut, which revolves with the casting on the lifting screw. This opens or closes the space between the castings and cuts off as much of the air feed through the horizontal tubes as may be desirable. The efficient point of feed being found, the concave casting may be set more or less permanently. Each headpiece is so formed that it is an inverted tank, or float, the whole construction being suspended by the lifting screw with the capstan nut supporting it fixed in I-beams of the building.


Fore Bay Water Line
Blow Off Water Line
Air Chamber Capacity 80,384 Cu. Ft.
242 ft.
40 ft.
Water Power Head 71 ft.
342 ft. Air Pressure Head 271 ft.
Tail Water Line
12 Blow Off
24" Air Pipe
Blow Off
Air Pipe Connecting with Mill and Mine

VERTICAL SECTION OF TAYLOR HYDRAULIC AIR COMPRESSOR AT VICTORIA MINE, MICHIGAN

METHOD OF CONTROL

To operate the compressor, the headpiece is lowered by turning the capstan nut until the lower rim of the upper conoid casting drops a few inches below the water level in the forebay; in this position the water rushes in between the mass of ⅜-inch air tubes, entering the opening between the two conoid castings on its course to the shaft. The water, on passing the end of the small air pipes, begins to drop away at an increased velocity, causing a partial vacuum to be formed, drawing the air through the ⅜-inch air tubes and inclosing small bubbles in the descending water and carrying them down the shaft, gradually compresses them, at the same time taking up the heat of compression.

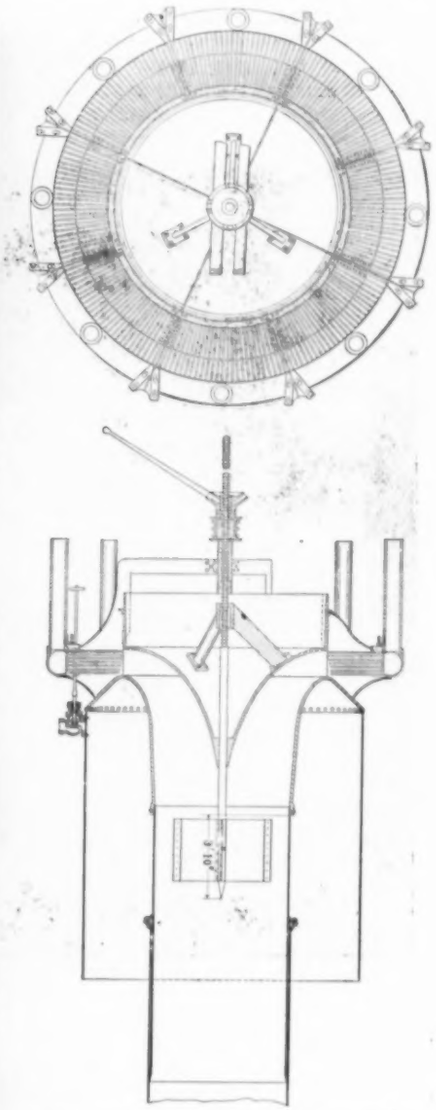
At the lower end of the shaft the mixed volume of air and water is spread out in all directions by the conical cement pier, and slowly flows along the separating chamber to the outlet tunnel and shaft. The air rises through the flowing water, having sufficient time to separate and accumulate in the dome of the chamber, forcing the water down till it reaches the lower end of the 12-inch escape pipe. This it unseals and allows air to rise and mingle with the water in the pipe. The water becomes too light to resist the air pressure, and is forced out of the upper end at the surface. The surface air continues to escape, preventing the water from being forced down any lower in the chamber by the further accumulation of air. If air is drawn off through the 24-inch air main to the full capacity of the compressor, the water rises in the chamber till it seals the lower end of the escape pipe, filling it with water and preventing the air from escaping. It remains there until a further surplus is compressed, causing it to repeat its action. The water, free from air on reaching the end of the chamber and tunnel, flows up the incline shaft, discharging into the tail-race.

A constant hight of 271 feet gives a steady pressure of 117 pounds per square inch, varying only when the compressor is overworked. In this case so large is the chamber, and so great the compressing capacity of the works. (more than 36,000 feet of free air per minute) that air may be drawn off at the rate of 72,000 cubic feet per minute for a period of 18 minutes without causing a drop in pressure of more than 5 pounds, delivering double the power of the compressor during that period, and accumulating again as soon as the extra demands are withdrawn. It, therefore, has special advantages in cases of wide fluctuations of power and a limited supply of water.

AUTOMATIC REGULATION

The heads are raised and lowered automatically by means of an air connection by way of a small pipe in the side of the shafts from the chamber below. The base of this pipe is so placed that when the

DISCHARGE END OF AIR CHAMBER. SUSPENDED END OF BLOW-OFF PIPE 4



PLAN AND SECTIONAL VIEW OF HEADPIECE, HYDRAULIC AIR COMPRESSOR

compression of air has proceeded sufficiently it lifts the rim of the lower conoid casting and prevents the further flow of water over the 1800 atmospheric feed pipes, thus stopping compression. The tanks thus utilized to lift the conoid casting leak air automatically through an adjustable valve. As soon as the pressure below is relieved, they drop the casting back into place, and the automatic flow of water down past the mouths of the minute feed pipes recommences.

There are three vertical shafts for the reason that they give greater efficiency with less water during a dry season than one, and by this arrangement a very high efficiency is secured through a range of from 1000 to 5000 horse-power. As the power requirements of the Victoria plants are about three-fourths of one head there has never been occasion to operate the three. With one head running at full capacity the surplus air escapes through the blow-off, throwing streams of mixed air and water fully 500 feet into the air, like some mammoth geyser, with a frequency and hight exceeding that of any of the famous geysers of the Yellowstone. The beauty is fully equal to that of the natural spouters.

BASES OF SHAFTS AND SPREADING PIERS IN MAIN CHAMBER

EFFICIENCY OF THE PLANT

Air from this plant is conveyed about a mile to the mine, through a 12-inch pipe. There it supplies 15 to 20 Rand drills; seven pumps of 150 to 200 gallons capacity each, raising mine water from a depth of 2200 feet; one hoist running at a speed of 1500 feet per minute, and requiring 500 horse-power, other engines for cable lines, crushers, stamp and saw mills, shops, stamp head crushing 350 tons of rock daily, and other machinery. The mill inclosing the stamp head and mill engine is 500 feet from the compressor. With these duties the gage pressure at the end of the air main has never varied.

Tests made by Messrs. Sperr and Hood, of the Michigan College of Mines, have shown the efficiency of the plant to be 82 per cent. when running at nearly maximum capacity. For all practical purposes it makes little difference in a plant of this sort, running on an abundant supply of free water, whether the efficiency is more or less, and perhaps if it were not for the resistance of the air bubbles descending the shafts it would be even higher than recorded.—*The Engineering and Mining Journal.*

Engineering, of London, publishes a review of Prof. Wm. H. Bird's book on the design and construction of metallic bridges, in which the reviewer says that the earliest use of wrought-iron plate girders, having thick webs and angle bar flanges, was probably in St. Petersburg, for public buildings, some years previous to 1847, at which date Wm. Handyside referred to the matter at a meeting of the Institution of Civil Engineers.

The Professional Educator and Trade Schools

BY ENTROPY

Professor Hanus, of Harvard University, chairman of the Massachusetts Industrial Education Commission, took part in a discussion of the subject of trade schools before the Worcester (Mass.) Economic Club, December 21. After seeing and hearing Professor Hanus I wish to withdraw any uncomplimentary things which I have said in these columns about college professors in general, and, so far as Professor Hanus is concerned, in particular. In spite of having no personal acquaintance I should unhesitatingly say that he is an active, aggressive worker, a man likely to see things as they would appear to such a worker in commercial lines, if they were presented to him in the same way.

THE MASSACHUSETTS TRADE-SCHOOL IDEA

As many of your readers know, Massachusetts has taken a step toward the establishment of trade schools, and a part of this step is the commission of which Professor Hanus is the chairman. This commission, it seems, is giving favorable attention to a scheme to provide a two-year high-school course, for boys between 14 and 16, which shall be practically a manual training course with vocational studies thrown in. The course is to be so general

as to be of value in leading up to any and all trades. It is expected that at the end of this time the pupil will choose a trade, and he may go to the shops of any manufacturer and learn it, or, possibly, the State may provide a way.

THE DANGER OF THE SOCIAL EDUCATOR

Just what studies, regarded as vocational, may be of value in any trade has not, so far, been made public nor is much said about the lines along which the manual training is to be done. This proposition very evidently comes from the social educator. The danger to be feared from this source has already been touched upon in these columns by me. It is inevitable that a clashing of opinions should come. Educators, naturally, feel that all education is within their province; and, since through all the years their work has dealt with books, drawings and lectures, and with things which may be learned through the organs of sight and hearing, it may be that caution should be used in letting them teach trades which involve also the use of touch and of an unnamed sense, which is a sort of mechanical or trade intuition.

Every trade has its "tricks"—not ways of cheating, but things which only experience can teach. No amount of book learning can teach a boy to weld two pieces of iron together; no amount of showing can do it. Experience can teach it so that the trick can never be lost.

THE VALUE OF BOOKS DEALING WITH TRADES

Under our present system of education any boy or girl who can read and write, can, if ordinarily bright and extraordinarily persistent, learn to teach any of the ordinary college subjects with almost no aid except from books. Can he do the same with a trade? There are plenty of books, such as they are; but of what value are they? Go to the library and get a book on carpentry. Here is the first one; it shows a beastly picture marked "hand saw," another marked "plane," and so on. Then it wanders off into the mysteries of stair rails and Chippendale table legs and hand carving, and it is English, anyway. The next one tells how to compute the angles to cut off rafters on a hip roof, and so on. The machine-shop books are worse yet. I know because I helped write one. The way these are written is about like this: the author gets all the trade catalogs that he can think of and clips out about an equal number of cuts from each so as to be impartial. Then he gets some other book on the same subject, and looks it through to be sure he does not leave out anything that the other book has. Then he puts in about an hour to a chapter writing something original about something he knows nothing about, and fills up the rest with descriptions of the cuts, varying from the catalogs only where he feels safe, which is usually the wrong place.

TEACHING THE TRADE FROM BOOKS

This may be overdrawn, but if anyone has written a book on machine-shop practice, since Joshua Rose wrote his, that has been done on any other plan, I wish he would call my attention to it. If a man who wished to teach the machinist's trade should start to do so from what he could get out of these books I fear he would not be a success. Nor would he do much better if he should go around and talk with a number of machinists and get their views. What he must do is to get into his overalls and work. He must try everything; he must try the bad ways of doing a job as well as good ones, so that he may acquire that instinctive appreciation of the results of good and bad methods. When he has done all this, will he write a book about it? Perhaps he will, but probably not. He will know that there is no way of transmitting certain things to another person. It will be to him as if he had lost the power to speak or write of certain things; he knows, but he cannot tell.

THE REAL KNOW HOW

I remember once I was trying to bore out a stuffing box in an old lathe. When I tried to clean up the bottom of the box with a wide-face tool it chattered. I did everything that I could think of to stop it, for an hour or more. Finally, I hailed the boss, and got him to look at it. He whistled, ran the tool in, did just what I had done without loosening a bolt or a nut, cleaned it up as smooth as a die without a chatter mark and started off. I asked for an explanation. "Well, sonny," he said, "that lathe knows me and it does not know you; that's all."

That is about what every man finds out, and that is why there is no use in expecting many better books than we have now. There is no written language to express the real essence of the trade. To a man initiated in the trade the articles in the AMERICAN MACHINIST are clear; to others they are jargon.

THE PROFESSIONAL EDUCATOR MUST FAIL

This is the place where I expect to see the professional educator fail—he will not know how to pick the right man to conduct his schools. His method is good for the exact sciences, but trades are not exact sciences. A man to successfully conduct a trade school must know the trade from A to Z; he must have judgment, which is the opposite of science; he must know whatever science there is in the trade; he must be able to systematize and to individualize, and he must know when to do one and when the other; he must be broad-minded and well read. In all he must be a man who can command from the business world a position such that, if he takes up with trade-school work, it will be because he is willing to make a sacrifice for the love of the work. Will Massachusetts search out such men? If she does she is safe; if she does not, then trade education will receive a set-back that will put us in serious want for skilled men for years to come, and give us a handicap for prosperity that will be gladly greeted by our competitors.

MANUAL TRAINING VS. TRADE TRAINING

I may be unnecessarily worried, but I feel that this tendency to establish a high-school course of this nature will be an ill advised step. Manual training is avowedly not trade training. Any mechanic can learn that in a half-hour if he will visit any manual training school. Two years spent on work which may be of value in any trade precludes anything but the most general work, and can hardly be better than a sop thrown to trade education.

Beginning at 14 years with light hours of work is none too early in my mind. The most receptive years follow then. The settling down to careful work cannot come till later, but then is the time to teach new ideas. It may be said that a boy is too young to select a trade then, and that his father ought not to force a choice. I do not think that ought to be a difficulty. What harm is done if he learns the wrong one? One of the brightest and best known lawyers that I have met learned the machinist's trade. It did him no harm. I do not think that the learning of any trade should be considered the end of all things. To get workmen who will stay workmen long enough to make it worth while to educate them, I believe it desirable to reach down below the grade of those who now fill our technical schools; but even for these, I believe that the learning of any trade will make it easier to learn another, if a boy should wish later to make a change. Nor do I believe that the learning of a trade would make it in any way harder for a boy to take up any of the professions with success.

WHAT TO DO ABOUT IT

What can be done about this trade-school matter in Massachusetts? The hearings which the old commission held were very perfunctory affairs so far as employers went. I do not see that any good would result from more hearings; but if every man to whom this matter does appeal will write down his ideas and send them in to the AMERICAN MACHINIST, and get as many published as the editor will make room for, I will take it on myself to see that the commission gets a copy of every paper which has anything on the subject. If the reader is too bashful to appear in print or the editor will not print what he writes, send it to Prof. P. H. Hanus, at Harvard University. Do not let the biggest chance to get valuable trade schools get side-tracked for lack of a letter. Such a statement of the case may be the turning point of the whole matter.

In various newspapers we see many references, sad and otherwise, to the abolition of the practice of giving passes to newspapers. Let us remark that the AMERICAN MACHINIST is one of the few papers to which the abrogation of the pass privilege is of no direct importance. It pays its way and always has.

THE U. S. NAVAL GUN FACTORY AT WASHINGTON, D. C.—V

The South Gun Shop, in which the Smaller Guns are Constructed—A Large Collection of Gun Lathes—The Breech Mechanism Shop

BY H. J. KENNEDY

Extending south from the shrinking pits is the division of the long building known as the south gun shop, which is 427 feet 11 inches long, 80 feet wide, 34,234 square feet in area, and which shows in Fig. 16 beyond the shrinkage pit. In this portion about 150 men are employed on the construction of guns from three inches to 10 inches in diameter. Though originally dating back to 1859, the shop was put in its present form in 1899. It contains about 15 gun lathes, and a number of large lathes for turning various parts of the breech mechanism, a rifling machine, etc. The crane service consists of the 15-, 25- and 40-ton cranes, which also run over the north gun shop, and were described in the section relating to that shop.

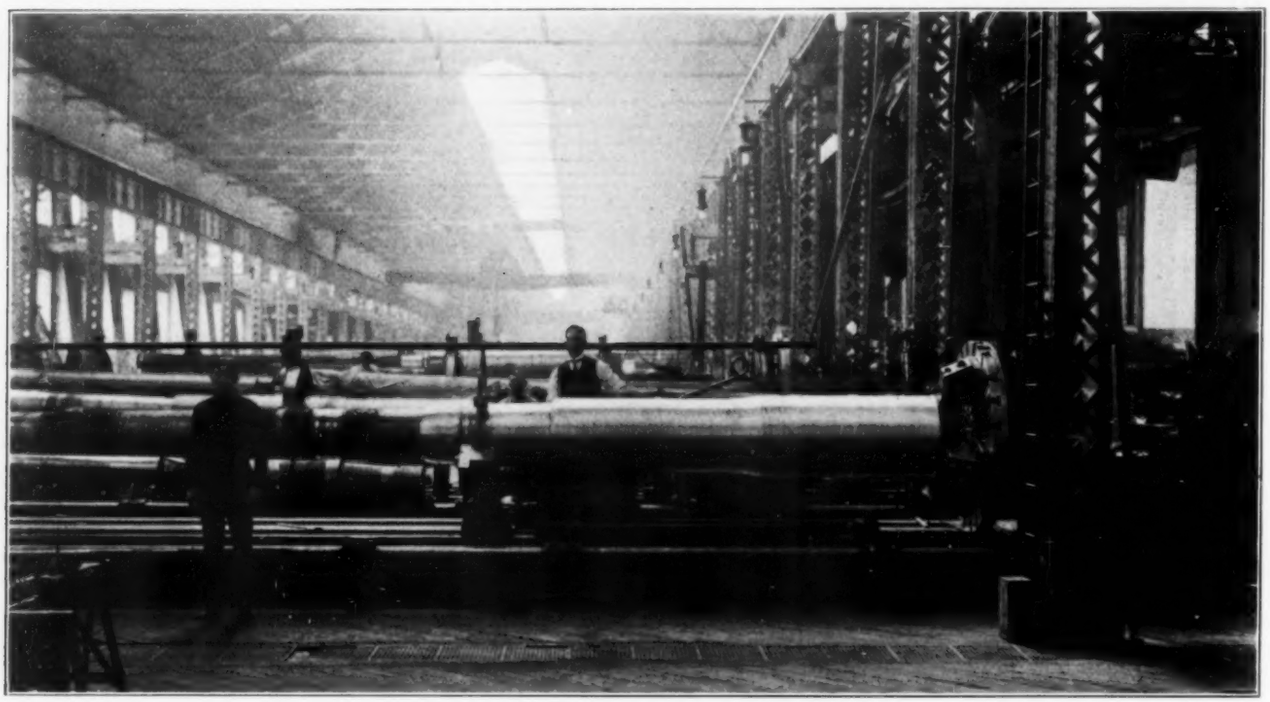


FIG. 30. SOUTH GUN SHOP, LOOKING SOUTH FROM SHRINKAGE PIT

The construction of the smaller guns being similar to that of the big guns made in the north gun shop, it is not necessary to repeat the description of the process, but it may be interesting to mention the hoop arrangement of such a gun. The six-inch 50-caliber gun, mark VI, has a tube and jacket, and in front of the latter a chase hoop, known as the *E* hoop; then outside of the jacket are the jacket hoops, hoop *A* being at the breech, hoop *B* next in front of it. There is also a short, jacket-locking hoop *C*, which is merely screwed on. In the six-inch 50-caliber gun, mark VIII, the chase hoop extends from the forward end of the jacket to the muzzle.

THE GUN LATHES

The first lathe south of the shrinking pit is shown in Fig. 30, and it also appears in Fig. 31. It is a machine with a 58-inch face plate, built by Bement, Miles & Co., and has a carriage travel of 40 feet, bar travel of 40 feet, and an eight-inch bar. In the picture it is turning a six-inch gun, having a breech diameter of 24 inches, a muzzle diameter of 11 inches and a length of 25 feet. Two tools are in use taking a one-inch roughing cut with a feed of 0.07 inch, and a cutting speed of six feet per minute. To the left, in Fig. 31, is the second lathe, a 51-inch machine by the same builders, with a carriage travel of 30 feet, bar travel of 40 feet, and an eight-inch bar, engaged on chambering a six-inch gun; one tool being in use with a cut of ¼ inch and a feed of 0.04 inch, cutting speed six feet per minute. The chamber is eight inches in diameter and 44 inches long, and tapers at the end.

The next three machines are 86-inch lathes, built at the navy yard about 24 years ago; on them the first 10-inch gun built in the United States was made, and the first four 12-inch guns in the United States were built on them.

The next machine is a 60-inch lathe, built by Bement, Miles & Co.; in Fig. 32 is a rear view of it showing the headstock. The bed is 89 feet long, and the machine has two carriages, will take 40 feet between centers, and it has a 6¼-inch bar. It is shown at work boring the tube for an eight-inch gun; one tool is in use taking a ⅜-inch cut with a feed of 1/32 inch.

Continuing southward, we pass in succession the following tools: a 100-inch lathe built by the Newark Machine Tool Company; a 67-inch lathe built by Reaney Sons & Archbold; another 100-inch Newark lathe; two 75-inch lathes built by Bement, Miles & Co. for 10-inch guns; a lapping machine, similar to the one in the north gun shop already described, this one being used for guns from three inches to seven inches; a 50-inch lathe; a boring lathe swinging 66 inches, and another one swinging 48 inches, all three built by the

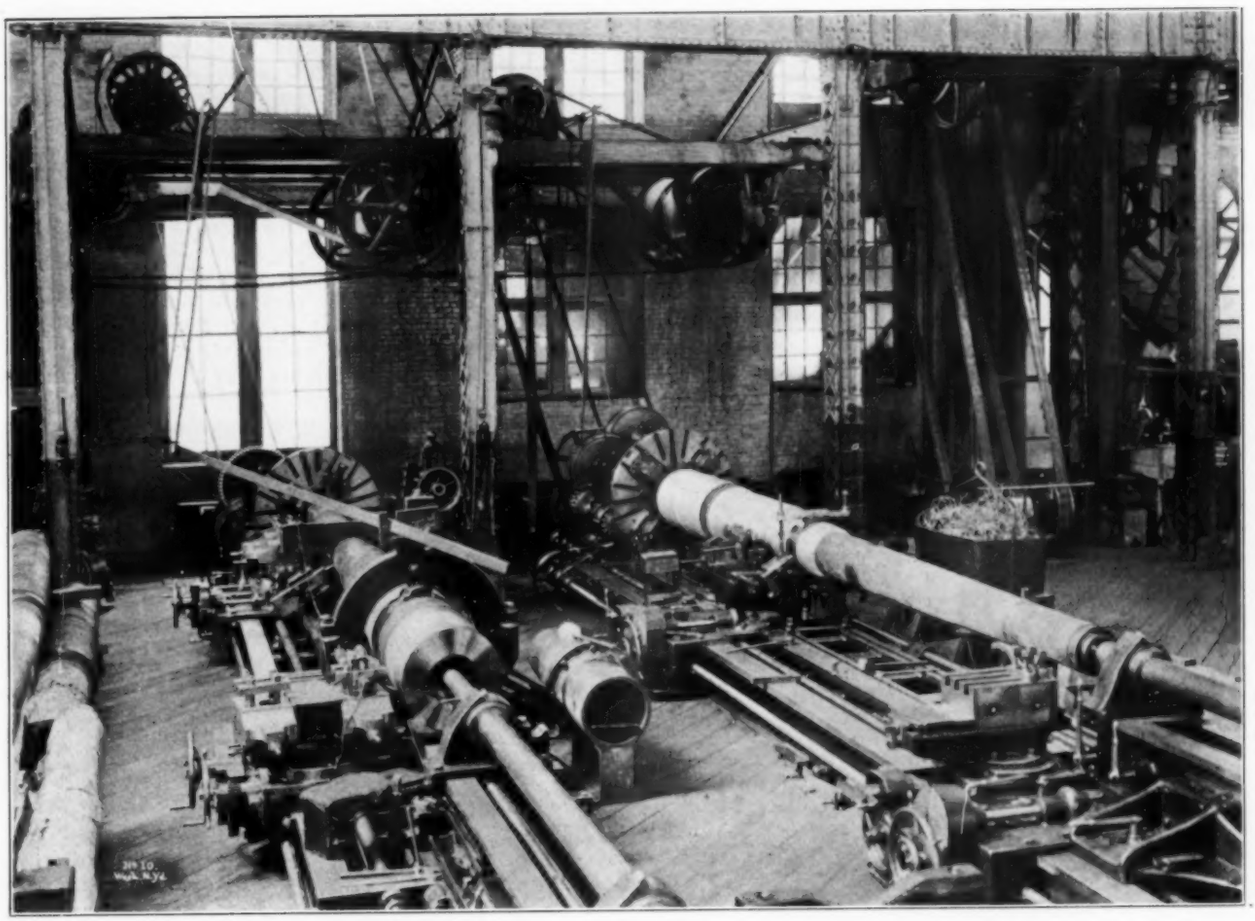


FIG. 31. TURNING AND CHAMBERING SIX-INCH GUNS IN THE SOUTH GUN SHOP

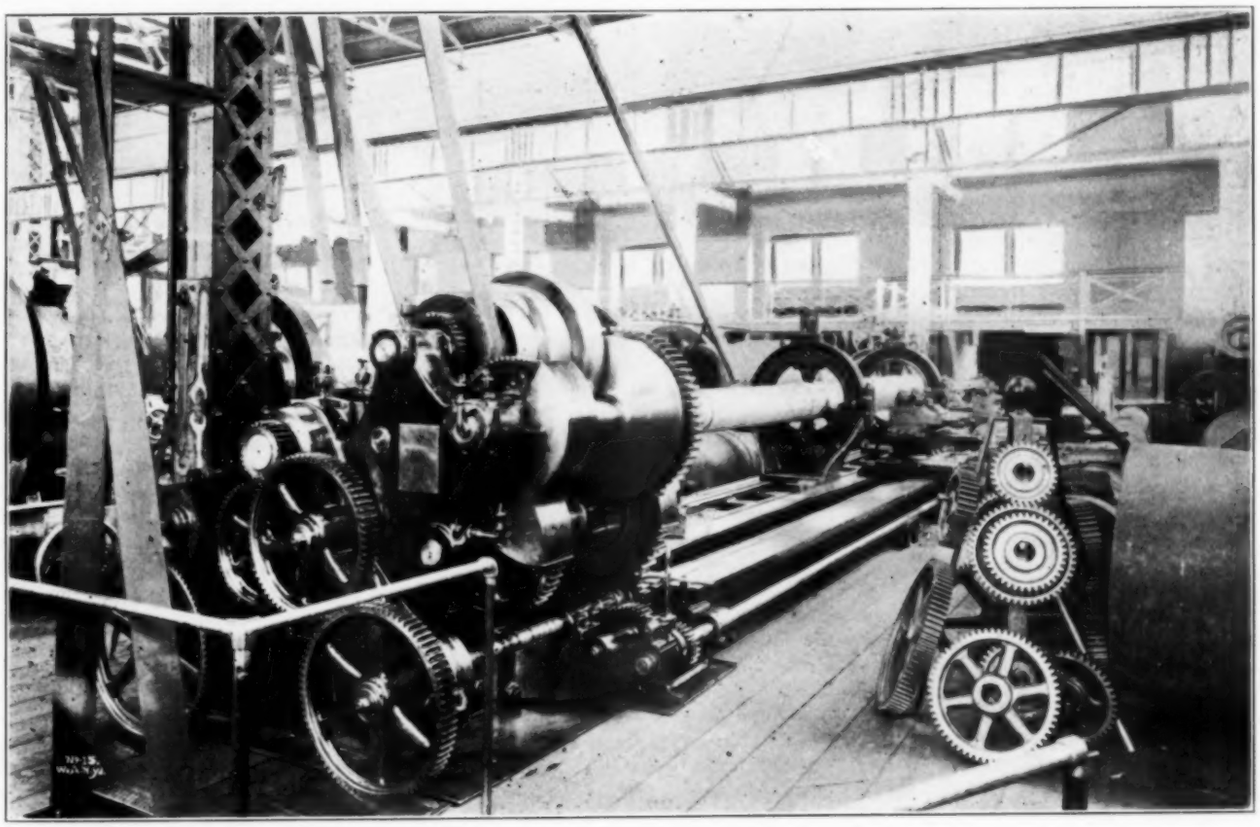


FIG. 32. BORING THE TUBE FOR AN EIGHT-INCH GUN IN THE SOUTH GUN SHOP

navy yard; and next comes a 48-inch lathe built by Bement, Miles & Co., shown in Fig. 33, boring a hoop for a six-inch gun. The carriage travel of this lathe is 24 feet, the diameter of the bar is 5¼ inches, and its travel is 24 feet. The hoop has outside diameters from 11 inches to 15½ inches, and its length is 15 feet. The bore is of four different diameters, namely, 8 inches, 8.65 inches, 9.20 inches, and 13 inches. Two tools are used taking a ⅝-inch cut with a feed of 1/64 inch.

At this point there are two rows of machines in the shop; on the east side are five Detrick & Harvey lathes, having 48-inch face plates, and taking 13 feet between centers; on the west side are, first, a John Roach 84-inch lathe, then two lathes built at the navy yard, 64 inches and 48 inches, respectively; then another Roach 84-inch lathe, then another navy yard 48-inch lathe.

Below these two rows are five 48-inch lathes built by I. H. Johnson & Co., and a rifling machine built by the navy yard, and on the same general principles as the one in the north gun shop, this one being used for guns from three inches to eight inches. At the end of the shop are two 48-inch lathes built by Putnam and Hewes & Phillips.

The machines in this shop are electrically driven on the group system, there being on the west side of the shop two 35-horse-power and one 50-horse-power motors, and on the east side one of 35 horse-power, run by 220-volt direct current. Two 10-inch gun lathes have independent motor drives, the main motors being 35 horse-power, and the motors on the quick-shafts 10 horse-power. In the north gun shop the main motors on the gun lathes are 56 horse-power.

THE BREECH MECHANISM DEPARTMENT IN THE SOUTH END OF THE GUN-SHOP BUILDING

The last 250 feet of the gun-shop building form the breech-mechanism shop, the central portion of which is devoted to the assembling, while the machines are located along the sides of the shop. This portion is entirely new, having been built in 1899 as previously stated; its width is the same as that of the south gun-shop, and its area is 20,000 square feet. Guns up to 10 inches in size are brought down to this department to have the breech mechanism and sight mountings fitted, guns larger in size than these having their sights fitted to them in the turrets on board ship. There are about 125 machines in this department, and about 350 men are employed in it. It is served by the same overhead cranes as run over the south gun shop. At present the shop is not capable of making all the sights that are required, and hundreds of them are being made by contract, the work being divided among several private shops. They are, moreover, making here firing locks and electrical firing attachments, and also an electrical night-sight lighting attachment.

Fig. 34 is a general view showing this shop, and is taken looking northward toward the gun shop. In the foreground to the left is a lot of breech-plugs, with interrupted threads on the inside, referred to in the previous article. The first machine to the left is a Pratt & Whitney double horizontal milling machine, having a table 14x6 inches, a head traveling nine inches, an inward travel of seven inches, and a three-inch spindle. This machine was not in operation at the time the picture was taken. Next beyond this are two Bement, Miles & Co. vertical milling machines, having tables 27x36 inches. The first machine is working on a portion of a gun mount, and the second one on a breech block for a 12-inch gun. The next machine beyond this is an old Niles horizontal boring, drilling and milling machine, having a table 3x5 feet. Beyond this is a Bement, Miles & Co. slotter, with 24-inch stroke, and table three feet square. This machine is engaged in slotting the thread surfaces of a breech block. Beyond this is a 24-inch Niles slotter. On the right is a Bement, Miles & Co. radial drill, having a radius of 60 inches, table 36 inches in diameter and a 2½-inch spindle.

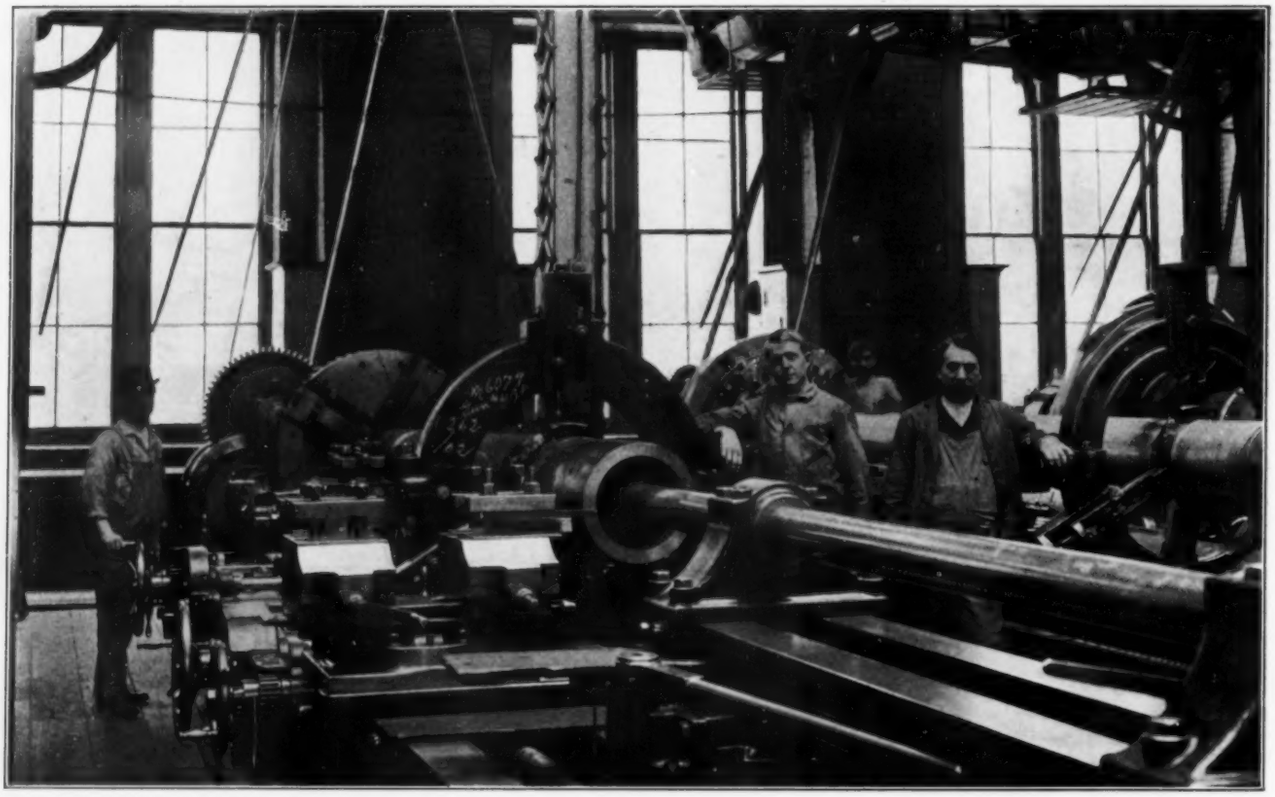


FIG. 33. BORING HOOP FOR A 6-INCH GUN, LOWER END OF SOUTH GUN SHOP

Fig. 35 is another view of this shop also looking northward, taken from a somewhat different standpoint. On the left are the slotting machines, and on the right a radial drill press with a six-inch gun under it, and a planer. The pile of guns on the right in the foreground are three-inch, 50-caliber, with a few three-

FIG 34. LOWER END OF GUN-SHOP BUILDING, LOOKING NORTH, SHOWING BREECH-MECHANISM DEPARTMENT

FIG. 35. BREECH-MECHANISM SHOP, LOOKING NORTHWARD

pounders down on the floor. In the middle of the picture is a horizontal boring, drilling and milling machine with steady-rest revolved by electric motor, referred to in the previous article.

Fig. 36 is a view of this shop taken looking in the other direction. The gun shown mounted on its carriage in the middle of this picture is a five-inch, mark IX, navy gun, length 16 feet 8 inches, diameter of breech 16¾ inches, diameter of muzzle 8¼ inches. On this gun can be seen the yoke through which pass the piston rods from the two recoil cylinders, as described in the second article of this series. The machine in the immediate foreground on the right is a Bement, Miles & Co. slotter, having a 36-inch table and stroke of 18 inches. It is at work slotting the extractor seat for the screw-box of a three-inch gun. To the left of the picture beyond the gun tube can be seen a number of recoil slides for five-inch and six-inch guns.

Fig. 37 is another view taken looking south, and the mounted five-inch navy gun, which shows in Fig. 36, is here also a prominent object. The gun shown lying on the floor to the left is a five-inch 40-caliber navy gun, having a breech diameter of 14 inches and length of 16 feet 8 inches. It is in the process of having its sights set. In the center of the shop are six-inch 50-caliber, and five-inch 50-caliber guns, having their breech mechanisms fitted. Back of these is a horizontal boring, drilling and milling machine, made by Detrick & Harvey, and engaged on drilling a six-inch gun for the breech slide. On the right side of the picture are the machines described under Fig. 34.

This completes the description of the long gun-shop building.

Cast iron is so porous and contains so many imperfections that any kind of electro-deposit is very apt to spot and peel off. This is particularly true of large cast-iron articles. In Paris, the cast-iron lamp posts and the beautiful fountains of the Place de la Concorde are copper plated, but not directly upon the iron. The cast iron was first coated with a varnish. This was then allowed to dry and graphite applied. The copper was directly deposited over this in the same manner that electrotyping is done. There is then no danger of spotting or peeling, as no solution comes in contact with the iron. The copper is deposited for from four to five days. —*The Brass World.*

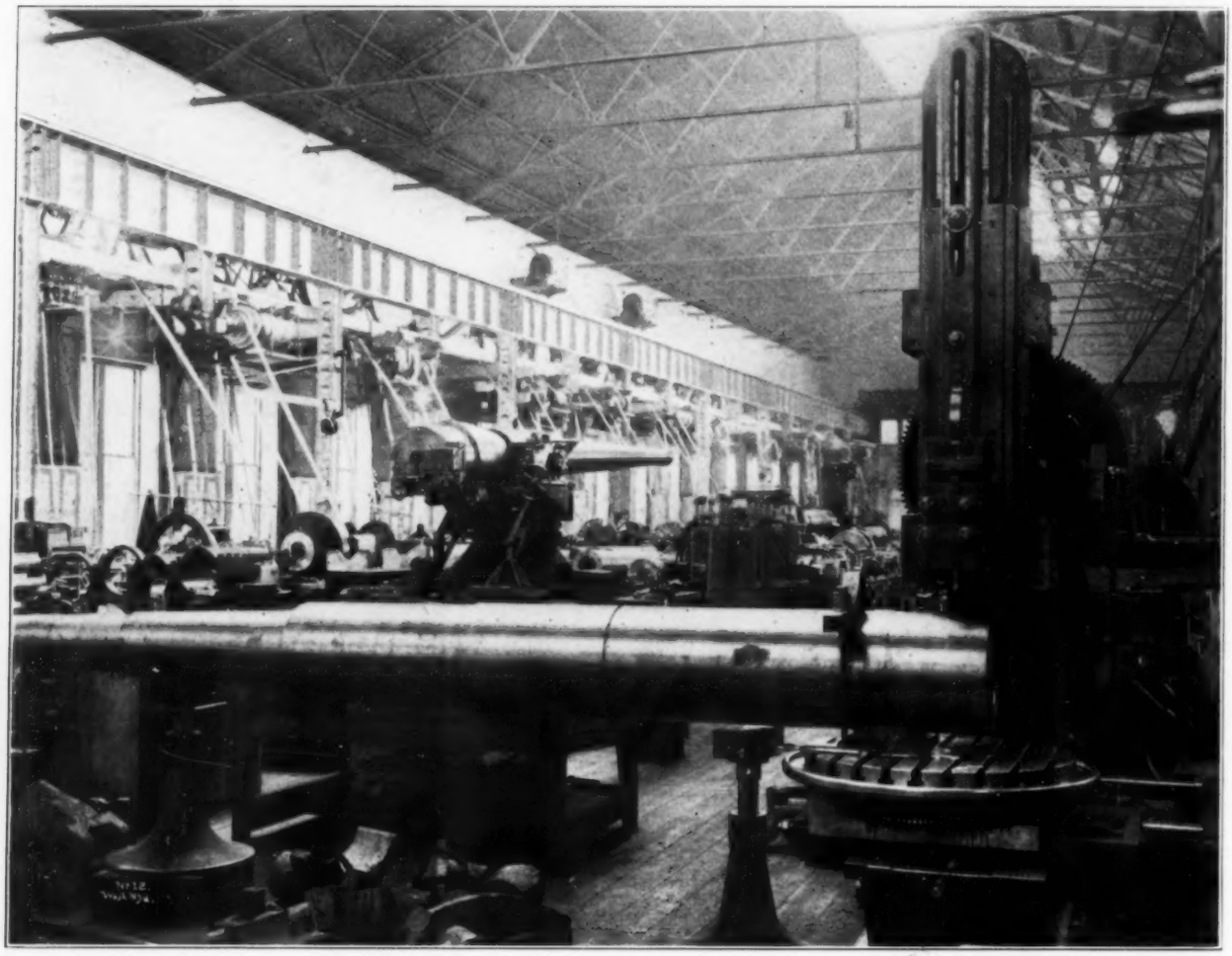


FIG. 36. BREECH-MECHANISM SHOP, LOOKING SOUTHEAST; 3-INCH GUN ON THE SLOTTER

Engineering Periodicals and the Card Index*

BY H. WADE HIBBARD

Among the most valuable members of the engineering profession today are the moving spirits of the engineering press. Much matter of great value is regularly to be found in the current periodicals of a profession growing so rapidly and in so many directions as is mechanical engineering. Books, monographs upon particular subjects, necessary as they are by their gathering within one cover all the required material of years and many places, and by their orderly classification, logical discussion, and evolving of principles, are, by very necessity of their production, always and inevitably behind the times. The reason for existence of the engineering press is to collect all recent valuable information—news, if you please—and present it weekly or monthly, less or more digested, to as large a circle of readers as possible. Unthinkingly or deliberately to neglect forming acquaintance,

*An address before the students of the Society of Mechanical Engineers, Sibley College of Mechanical Engineering, Cornell University.

with so great a source of engineering knowledge is not fitting for the student who has his own future to make in a country where ruts and old fashions are only for the failures.

Habits are excellent balance wheels, generally. Brilliancy being given to but few men, the great majority must hammer out lesson or problem or engineering feat. Genius has been defined as an infinite capacity to take trouble. Regularity of mind, a habit of undivided intensest application, may place the worker far beyond the one who thinks to accomplish by fits and starts. It is well to form the habit of regular perusal of the weekly engineering papers. Student life is called full by those in it; but it is leisure personified compared to the high-pressure life of the successful engineer in the harness. Let then the student distrust his ability to commence reading the technical papers after graduation, unless he has learned to read them before.

Independent investigation is promoted by reading the papers. A printed controversy stimulates anyone who loves a fight. Blessed be the man whose engineering eye is fired and mettle aroused by the prospect of a battle royal between men of fame. Perhaps he too can put in a lance, if extra spare hours or thesis subject will permit.

After the different papers become known, then the heart of the very human editor should be gladdened by a little note of appreciation; with some of that necessity for which he works, though not chiefly. A good engineering paper should be one of the life partners, ready at hand when moments of leisure permit its instruction and enjoyment, better understood and liked as the years roll on, acquaintance or perhaps friendship formed with editor, contributions made, suggestions given and taken, some share had in its mighty influence in the engineering world. Years afterward, when official responsibilities come, this earlier training will bear good fruit. A superintendent's office will take regularly several papers or several copies of one most useful paper. He marks in these papers articles appropriate for the instruction or spurring of particular subordinates; and sends them out. Later he will call for meetings of these heads of divisions or departments in his office; and the resulting interchange of opinions on the papers, tempered with experience, will prove of decided advantage to the business, promoting unanimity of feeling between the departments and the introduction of the best methods suited for each or perhaps all. The speaker recalls with much pleasure such meetings on the Lehigh Valley, and has been told only recently by President Vreeland, of the Metropolitan Street Railway, of New York City, of the success attending his marking of such articles and sending them out, not merely to subordinates, but to some thousands of motormen and gripmen.

But what of that dimly remembered life-preserver which could not be found when there was dire need? Editors of papers, engineering and otherwise, are frequently in receipt of letters like the following: "A number of months ago I read an article in your paper, or one like it, bearing upon such a subject. At the time of reading I recognized its value. Not only did I think that I had its essential items impressed upon my memory, but I recall making some record in my note-book. I find now a problem has come up in my practice for which I greatly need, and at once, the information contained in that article, but I can find neither it nor my note, the latter being evidently hidden in the midst of other material. If it appeared in your paper, will you give me the date and if possible send me the copy? I am willing to pay a good price for it."

Even when one has the annual indexes of his engineering papers bound up with the volumes, it may be a search of hours to unearth an article whose general subject or whose most valuable details are more strongly impressed upon the memory than its title as appearing in the index. The average subscriber does not get the full value out of his paper, because of this very inability to find again what he has read.

FIG. 37. BREECH-MECHANISM SHOP, LOOKING TOWARD THE SOUTH END, SHOWING SIGHT-FITTING FLOOR

The card index will obviate the difficulty, giving ready access to what has been read by its maker, recording information in the form best adapted to his professional needs and to his own peculiar habits of mind and memory, and following his own pet system. The speaker gave up note-books 10 years ago, and commenced a card index, making it really a written memory of everything which "might come in handy some time"; of reading, of experience, of oral information; engineering, household, athletic, religious; references to catalogs, drawings, clippings; lists, future plans, addresses—everything.

The making of a card index is a growth. The easiest way to get started is to read the papers with slips in hand and foun-

tain pen or indelible pencil (ordinary purple copying) ready for use. Read an important article. At the top of a card place the subject of the article, very likely not the author's title of the article, but the *subject that appeals to your type of mind* after the reading. Right here is the most difficult part of a card index. You are in danger of indexing an article on compressed air under C the adjective, when it should be under the noun A; or blowers under B, when it should be under A as air blowers. Perhaps the most accessible guide for the inexperienced indexer is the table of contents of Kent's "Mechanical Engineers' Pocket Book," which every Sibley man must, of course, own. On page 447 of the American Society of Mechanical Engineers' *Proceedings* for 1896, a discussion on card indexes, Mr. Kent explains his method of general heads—e.g., to put everything relating to steam under Steam, as steam boilers, steam engines, steam pipes. The railway mechanical engineer should follow the "Car Builders' Dictionary," and the index of the Master Mechanics' Association, on page 67 of the *Proceedings* for 1900, to be revised by a special committee for the *Proceedings* of 1901.

Sometimes one is uncertain how to index some piece of information. Remember then that almost everything will have two parts—the thing and its function—and if the thing is the more prominent, catalog it under the thing; or if the function, then under the function; but (and the following is called "cross indexing") be sure and make out a card for the other and write on it: See the main card (giving its subject). A liberal use of cross indexing is no fault; one's mind does not always work on the same lines, and data *might* be buried even in a card index. Five years later one may not be able to recall just the one heading under which he indexed an article, but is sure to remember one out of the several headings of the cross indexing. After the subject is written on the card, add the name of the *paper, with year and page.* The card is as yet practically worthless. Add a *short description* of the article with your opinion of its value or applications. Perhaps you can place upon the card all of the article that is of value. At least enough must show on the card to give the future searcher after information some discriminating idea of the article and whether it will pay to read it again to aid him in his engineering problem:

Briefly, the card index then has the following advantages:

Accessibility—always get-at-able—nothing is buried and lost.

Time-saving—for the searchers after information.

Expansibility—only one end, the beginning. Can enlarge forever and still be as good.

Order—new material inserted into the exactly proper place.

Adaptability—suits every frame of mind, and every sort of business; varied classification.

System—encourages system in vast accumulating data and brings it under general heads of classification.

Divisibility—some cards can be removed for temporary use elsewhere, or for permanent transfer.

Labor-saving—nothing has to be rewritten, saves clerical labor.

Simplicity—can be operated by the inexperienced.

Contractibility—no need of retaining useless, outgrown matter.

No wasting of spaces—it is impossible to apportion blank spaces in books so that they will fill evenly.

Always being up to date.

Rearrangement made easy.

Substitute for memory—supplementing it and becoming independent of existing hired memories.

Classifications within the index—by using tab cards.

In conclusion be it said that engineering periodicals and the card index are not the fabled philosopher's stone, turning all metals into gold; but an unfading love for our profession can use them, among the other reagents, to bring out the measure of true worth within the capacity of each man.

Metallizing Flowers and Objects

Consul-General George W. Roosevelt, of Brussels, reports the successful development there of a new method of making bronze-plated objects, as follows:

The first attempt at metallizing objects was known to the industrial world as long ago as 1861-66, when unsuccessful efforts were made to metallize flowers, fruits, etc. After six years of laborious research and experiments, H. Monge and C. Arzano succeeded in perfecting the art and recently established a factory at 17 Rue d'Irland Saint-Gilles, Brussels, for the manufacture of bronze-plated art objects, ancient and modern. By their process, the secret of which they jealously guard, they are enabled to metallize even so delicate a thing as lace or a rose in full bloom.

The object of this establishment is to place handsomely finished metallized objects on the market, in every particular equal to, but at one-eighth the cost of cast bronze, and to immutably fix the incomparable forms nature gives to her products, such as flowers, leaves, fruits, insects, etc. Of these the most skilful have heretofore only furnished fair imitations by covering the object by electrolytic means with an exceedingly thin but as dense as possible coating of brass, which transforms the natural objects into bronze.

Without disclosing secret methods of metallizing, no hesitancy was observed concerning a description of the length of time that objects were retained in what is known as the bath. The length of time varies according to the character of the object, and the complication of its detail, from 24 to 72 hours. The subjects selected for metallizing are generally well known works of famous artists, objects for decorative purposes, and artistic objects, such as card and ash receivers, frames, etc. The finished articles, which resemble in weight, texture, color, etc., real bronze, are entirely different from any manufacture now on the market, as they are declared chemically pure copper and not a mixture or composition. Julius and Arthur Hart, of Indianapolis, Ind., and Los Angeles, Cal., are representing members of the firm in America.

Germany's Commercial Advance

The total foreign trade of Germany, according to Consul-General A. M. Thackara, of Berlin, amounted in 1905 to $3,160,187,800, an increase of $263,704,000 over 1904, the increase in imports being $138,468,400, and in exports, $125,235,600. Among the exports, the value of domestic manufactured goods shows a great increase and food products a decrease, indicating Germany's advance as a manufacturing nation.

Russia heads the list in the value of imports sent to Germany, the United States being second. If the gold imports were not considered, this order would be reversed. Among the articles imported from the United States the amount of machinery and tools is shown to be 20,631 metric tons for 1905, as against 15,794 tons in 1904. The large increase in the imports of American agricultural and other machinery is mostly due to the desire of the importers to lay in stock in anticipation of the higher duties of the new tariff law.

The consul states that the excellent and labor-saving qualities of the best grades of American machines are unquestionable, but the time has passed when those of inferior make can find a ready sale in Germany. The exposition held some two years ago in Düsseldorf was a revelation to American manufacturers, who attended it. The Germans exhibited lathes, drill presses and other machines, which for originality of design, construction, effectiveness and price were but little, if any, behind similar machines of the best American models. Agricultural machinery is also manufactured in Germany, which is becoming a competitor of that made in the United States. In 1905 Germany exported 14,562 tons of agricultural machinery, valued at $2,659,650; 6,187 tons of this went to Russia.

In 1905 the United States supplied 74 per cent. of Germany's imports of cotton, 88 per cent. of the copper imported, and 19 per cent. of the machinery.

During the past year 11,753 automoblie owners registered in New York State.

THE SHAPE AND DUTY OF ROUGHING TOOLS—III*

BY FRED. W. TAYLOR

The accompanying tables complete the extracts from this noteworthy paper and are of immediate practical usefulness in the shop.—Ed.

DEPTH OF CUT IN INCHES	FEED IN INCHES	CUTTING SPEED IN FEET PER MINUTE FOR A TOOL WHICH IS TO LAST 1 HOUR AND 30 MINUTES BEFORE REGRINDING		
		SOFT STEEL	MEDIUM STEEL	HARD STEEL
1/16	1/64	510	255	116
	1/32	322	161	73.2
	1/16	203	102	46.2
3/32	1/64	445	223	101
	1/32	281	141	63.9
	1/16	177	88.7	40.2
	3/32	135	67.4	30.7
1/8	1/64	404	202	91.8
	1/32	255	128	57.9
	1/16	161	81	36.6
3/16	1/64	359	179	81.6
	1/32	226	113	51.4
1/4	1/64	330	165	25.0

STANDARD 1/2-INCH TOOL

DEPTH OF CUT IN INCHES	FEED IN INCHES	CUTTING SPEED IN FEET PER MINUTE FOR A TOOL WHICH IS TO LAST 1 HOUR AND 30 MINUTES BEFORE REGRINDING		
		SOFT STEEL	MEDIUM STEEL	HARD STEEL
3/32	1/64	476	238	108
	1/32	325	162	73.8
	1/16	222	111	50.4
	3/32	177	88.4	40.2
1/8	1/64	420	210	95.5
	1/32	286	143	65.0
	1/16	195	97.6	44.4
	3/32	156	77.9	35.4
	1/8	133	66.4	30.2
3/16	1/64	352	176	80.0
	1/32	240	120	54.5
	1/16	164	82	37.3
	3/32	131	65.5	29.8
	1/8	112	56.0	25.5
1/4	1/64	312	156	70.9
	1/32	213	107	48.4
	1/16	145	72.6	33.0
	3/32	116	58.1	26.4
3/8	1/64	264	132	60.0
	1/32	180	90.2	41.0
	1/16	122	61.1	27.8
1/2	1/64	237	118	53.8
	1/32	162	80.8	36.7

STANDARD 7/8-INCH TOOL

DEPTH OF CUT IN INCHES	FEED IN INCHES	CUTTING SPEED IN FEET PER MINUTE FOR A TOOL WHICH IS TO LAST 1 HOUR AND 30 MINUTES BEFORE REGRINDING		
		SOFT STEEL	MEDIUM STEEL	HARD STEEL
1/16	1/64	548	274	125
	1/32	358	179	81.6
	1/16	235	117	53.3
3/32	1/64	467	234	106
	1/32	306	153	69.5
	1/16	200	100	45.5
	3/32	156	78.0	35.5
1/8	1/64	417	209	94.8
	1/32	273	136	62.0
	1/16	179	89.3	40.6
	3/32	140	69.8	31.7
3/16	1/64	362	181	82.2
	1/32	236	118	53.8
	1/16	155	77.4	35.2
1/4	1/64	328	164	74.5
	1/32	215	107	48.8
3/8	1/64	286	143	65.0

STANDARD 5/8-INCH TOOL

DEPTH OF CUT IN INCHES	FEED IN INCHES	CUTTING SPEED IN FEET PER MINUTE FOR A TOOL WHICH IS TO LAST 1 HOUR AND 30 MINUTES BEFORE REGRINDING		
		SOFT STEEL	MEDIUM STEEL	HARD STEEL
3/32	1/64	482	241	110
	1/32	323	161	73.4
	1/16	217	108	49.3
	3/32	172	85.8	39.0
1/8	1/64	423	212	96.1
	1/32	284	142	64.5
	1/16	190	95.2	43.2
	3/32	151	75.3	34.2
	1/8	128	63.8	29.0
3/16	1/64	358	179	81.4
	1/32	240	120	54.5
	1/16	161	80.5	36.6
	3/32	127	63.7	28.7
1/4	1/64	320	160	72.7
	1/32	215	107	48.8
	1/16	144	72	32.7
3/8	1/64	276	138	62.7
	1/32	185	92.4	42.0

STANDARD 3/4-INCH TOOL

CUTTING SPEEDS IN STEEL

*Extract from the presidential address before the American Society of Mechanical Engineers

The annual Register of Cornell University has grown to formidable proportions, its pages numbering 668. The total number of regular students is 3442, with 890 additional summer-session and short-course students. The college of mechanical engineering is by far the largest, with 1072 students. The college of arts and sciences comes next with 735, and the college of civil engineering next with 460. The faculty numbers 507, which exceeds the number of students in the old days.

In the legal note relating to "libel on manufactured goods," the words "latter" and "former" are accidentally inter-changed, at page 17, second column, eighth line. The context may have sufficed, however, to prevent a misapprehension.

Annealing Tool Steel—Some Difficulties Encountered by Steel Makers and Users and a Number of Things Learned in Treating Different Classes of Material

BY E. R. MARKHAM.

Mr. Gifford's letter at page 680 calls to mind many a tale of woe respecting the annealing of tool steel. I recall a visit to the office of a prominent steel concern. As soon as I set foot in the office I was greeted as follows: "Say, Markham, what are we going to do with these two complaints?" I carefully read the letters handed me, and will give in brief the contents:

FIRST LETTER—STEEL TOO HARD

"Gentlemen: Am sorry to report to you that the last tool steel purchased from your mill is so hard we cannot work it; at least we cannot work it with any profit to ourselves. We ordered this annealed, but evidently you read the order differently and hardened it; however, an examination of our bill shows you have charged us one cent a pound for annealing. This seems a fair price for annealing, but a low price for tempering. Kindly tell us how we stand," etc.

SECOND LETTER—STEEL TOO SOFT

"Dear Sirs: Evidently there is a misunderstanding in your office regarding our order of —— inst. If you examine our order carefully you will see that we ordered tool steel, not putty. The stuff is over annealed, we can do nothing with it. We are making, or rather trying to make, hob taps from the round, and dies from the flat, and it is so soft we can do nothing with it," etc., etc.

THE STEEL MAN'S QUANDARY

When I had finished reading the letters, my friend asked me to listen to his side of the story and then tell him what I thought. He said as near as he could find out the two batches of steel were annealed at the same time, in the same furnace; the carbon was practically the same in each, and so far as he could learn the steel was all alike, and neither lot had received any unusual treatment anywhere in the mill. "Now it is too soft for one chap and too hard for the other. Both are good customers and we are anxious to hold their trade; but, how can we please both, when their wishes are exactly opposite?"

TWO METHODS OF ANNEALING

My answer was: "Ask me something easy, but let us go out and interview the chap who had the annealing in charge." The investigation showed that while both batches of steel were practically the same and were annealed at the same time in the same oven, the method used in each case was radically different from the other. One lot of steel was incased in a tube with charcoal, while the other was heated without covering of any kind. One firm had written that they must have their steel extra soft, so it was "packed"; the other had simply ordered theirs annealed, so it was open annealed, and proved to be much softer than the other.

DEPTH OF CUT IN INCHES	FEED IN INCHES	CUTTING SPEED IN FEET PER MINUTE FOR A TOOL WHICH IS TO LAST 1 HOUR AND 30 MINUTES BEFORE REGRINDING		
		SOFT STEEL	MEDIUM STEEL	HARD STEEL
3/32	1/64	490	245	111
	1/32	339	169	77.0
	1/16	235	117	53.4
	3/32	189	94.5	43.0
1/8	1/64	427	214	97.0
	1/32	296	148	67.2
	1/16	205	102	46.6
	3/32	165	83.0	37.5
	1/8	142	71.0	32.3
3/16	1/64	358	179	81.3
	1/32	247	124	56.1
	1/16	171	85.5	38.8
	3/32	138	69.0	31.3
	1/8	118	59.0	26.8
	1/16	95.0	47.5	21.6
1/4	1/64	315	157	71.6
	1/32	218	109	49.5
	1/16	150	75.0	34.1
	3/32	121	60.5	27.5
	1/8	104	52.0	23.6
3/8	1/64	263	132	59.8
	1/32	182	91.0	41.4
	1/16	126	62.8	28.5
	3/32	101	50.6	23.0
1/2	1/64	232	116	52.7
	1/32	161	80.5	36.6
	1/16	111	55.7	25.3

STANDARD 1-INCH TOOL

DEPTH OF CUT IN INCHES	FEED IN INCHES	CUTTING SPEED IN FEET PER MINUTE FOR A TOOL WHICH IS TO LAST 1 HOUR AND 30 MINUTES BEFORE REGRINDING		
		SOFT STEEL	MEDIUM STEEL	HARD STEEL
3/32	1/64	518	259	118
	1/32	366	183	83.2
	1/16	257	129	58.4
	3/32	209	105	47.5
1/8	1/64	450	225	102
	1/32	317	158	72.0
	1/16	223	112	50.7
	3/32	182	90.8	41.4
	1/8	157	78.5	35.7
3/16	1/64	370	185	84.1
	1/32	260	130	59.1
	1/16	183	91.7	41.6
	3/32	149	74.6	33.8
	1/8	129	64.5	29.3
	1/16	105	52.6	23.8
1/4	1/64	322	161	73.2
	1/32	227	113	51.6
	1/16	159	79.7	36.1
	3/32	130	65.0	29.5
	1/8	112	56.1	25.5
	1/16	91.4	45.7	20.8
3/8	1/64	264	132	60.0
	1/32	186	93.1	42.3
	1/16	131	65.5	29.8
	3/32	107	53.4	24.1
	1/8	92.2	46.1	20.8
1/2	1/64	230	115	52.3
	1/32	162	80.9	36.8
	1/16	114	56.9	25.9
	3/32	92.6	46.3	21.0

STANDARD 1¼-INCH TOOL

CUTTING SPEEDS IN STEEL

PACKING STEEL IN CHARCOAL

Tool steel packed in charcoal and run for a considerable length of time seems to become granular in structure, and cuts hard. Many times a piece of steel treated this way proves hard, and the operator, thinking he has not treated it sufficiently, will pack it and run it again, giving it higher heats and running it

longer, and is surprised to find it harder than before.

EXPERIENCE WITH SOME DIE BLOCKS

I remember a lot of six blocks which were made from a special steel for a firm of engravers and die sinkers, and which were to be made into dies whose faces were to be engraved with complicated designs. These blocks were annealed by packing in boxes in charcoal. After being placed in the furnace they were carefully heated to what would generally be considered a good annealing heat, and the whole lot was allowed to cool off with the furnace. When machined the blocks proved to be very hard, so the "annealing" operation was repeated several times.

AN ANNEALING PROCESS THAT FAILED AND ONE THAT DID NOT

Each time they were heated hotter and kept at a red heat longer than before, with the result that they proved to be harder after each attempt to soften them. After several attempts with the result mentioned, the blocks were sent to another party, who heated them very carefully to a good annealing heat and as soon as they were uniformly heated throughout they were removed from the furnace, buried in hot ashes and allowed to cool. In this manner they were not kept red-hot for a great length of time but were a good while cooling down from a red heat.

RAPID HEATING

It is a fact not understood by everyone that steel should always be heated as rapidly as possible for the operations of hardening and annealing—that is, as rapidly as possible and yet get a uniform heat. The annealing heat should be as low as is consistent with desired results. If the only result sought is a workable condition of the stock, then a low heat answers nicely for most work.

HEATING TO REMOVE STRAINS

If, however, we wish to remove strains which are in the steel and would be apt to manifest themselves when the work was hardened, then it must be heated fully as high as when it is to be hardened. However, it is not necessary to heat it high enough to open the grain; and it is this granular condition that renders the steel difficult to work.

ANNEALING THIN PIECES

I was called to a shop a short time ago, where they were having trouble with their pieces of steel that were box annealed, by packing in charcoal and running for several hours. We changed tactics, heated the pieces in a furnace and when they showed a good low red they were drawn out into a box with hot ashes in the bottom. As others heated they were drawn out on top of these and this was kept up until the box was nearly full, then it was filled with hot ashes, placed where no current of air could strike it and left until cold. The steel was found to be in excellent condition to machine, and hardened nicely later on at low heats.

A GOOD METHOD OF TREATING SMALL LOTS

At one time I gave in the columns of the AMERICAN MACHINIST a method of annealing that I have used with uniformly good results for years when but a few pieces were to be treated. First and most important is the heating of the steel. As previously stated, heat as rapidly as possible, but do not under any circumstances allow any part to become overheated; and be sure that the heat *is* uniform throughout, that is, be sure the piece is as hot inside as at the surface, and that the corners do not get too hot and then cool down to the temperature of the balance of the piece, because the grain will surely show the effects of the higher heat.

ASH BOX FOR SLOW COOLING

In the bottom of an iron box place a couple of inches of hot ashes, and on this place a piece of board a trifle larger than the steel. The heated steel is placed on the board, a second piece of board is placed on the steel and the whole covered with hot ashes. The wood absorbs the heat and reduces it to a little below a red, and from this temperature it cools very slowly. By this method the steel

DEPTH OF CUT INCHES	FEED IN INCHES	CUTTING SPEED, IN FEET PER MINUTE, FOR A TOOL WHICH IS TO LAST 1 HOUR AND 30 MINUTES BEFORE REGRINDING		
		SOFT CAST IRON	MEDIUM CAST IRON	HARD CAST IRON
3/32	1/64	206	103	60.0
	1/32	147	73.3	42.8
	1/16	97.5	48.8	28.5
	3/32	76.0	38.0	22.2
	1/8	64.1	32.1	18.7
1/8	1/64	194	97.0	56.7
	1/32	138	69.3	40.4
	1/16	93.1	46.5	27.2
	3/32	72.1	36.1	21.3
	1/8	41.8	20.9	12.2
3/16	1/64	182	91.0	53.0
	1/32	128	64.0	37.7
	1/16	86.1	43.1	25.1
	3/32	67.4	33.7	19.6
1/4	1/64	173	86.3	50.4
	1/32	122	61.0	35.7
	1/16	81.9	41.0	23.9

STANDARD ½-INCH TOOL

DEPTH OF CUT IN INCHES	FEED IN INCHES	CUTTING SPEED, IN FEET PER MINUTE FOR A TOOL WHICH IS TO LAST 1 HOUR AND 30 MINUTES BEFORE REGRINDING		
		SOFT CAST IRON	MEDIUM CAST IRON	HARD CAST IRON
3/32	1/64	216	108	63.0
	1/32	160	80.0	46.6
	1/16	110	55.0	32.2
	3/32	88.4	44.2	25.8
	1/8	75.4	37.7	22.0
1/8	1/64	200	100	58.6
	1/32	148	74.0	43.3
	1/16	104	51.8	30.2
	3/32	82.6	41.3	24.1
	1/8	69.6	34.8	20.3
3/16	1/64	183	91.6	68.0
	1/32	135	67.5	39.4
	1/16	94.0	47.0	27.4
	3/32	75.4	37.7	22.0
	1/8	64.3	32.2	18.8
1/4	1/64	171	85.7	50.1
	1/32	126	63.2	36.9
	1/16	87.8	43.9	25.6
	3/32	70.4	35.2	20.6
3/8	1/64	156	77.8	45.4
	1/32	116	57.8	33.8
	1/16	79.7	39.9	23.3

STANDARD ⅝-INCH TOOL

CUTTING SPEEDS IN CAST IRON

is made sufficiently soft to work nicely, and the grain is in fine condition.

PACKING TOOL STEEL

The effect of heating tool steel, especially high carbon, for a considerable length of time, confined as already noted in a box or tube with charcoal, seems to be the same as that produced by the cementation process of converting iron to blister steel; and especially is this the case if the heats are above a low red. For my particular practice I have given up almost entirely charcoal as a packing material for tool steel. Where packing is necessary I use dry fire clay, but as a rule I use no packing material unless it is necessary to keep the pieces apart or to charge the surface of the steel with additional carbon to accomplish a desired result, in which case I use charred leather.

USUAL SOURCES OF TROUBLE

In the majority of cases where my services are required in looking up annealing troubles, I find that one or more of these reasons are responsible: (1) high heats; (2) uneven heats; (3) keeping the steel red-hot for too long a period; (4) injudicious use of packing material.

A Prayer for Quicker Deliveries

At first glance, the subjoined communication might be taken to be a translation of a letter from a Chinese or other polite Oriental; it was however, according to the *Industrial World*, addressed to a prominent Pittsburg concern by one of its representatives in the South, as a result of the unprecedented demand for all classes of machinery and the attendant difficulties in securing anything like prompt deliveries, and no doubt the state of mind of its writer reflects that of many a manufacturer's agent nowadays.

It has provoked considerable amusement in the trade:

"We beseech, thee, oh Mighty Factory! Ruling Potentate of the commercial world to bend thine head and open thine ears to our humble pleadings from the persecutions of our indignant customers.

"We realize, Oh Factory, that we are but thine humble servant and that our daily acts should but please thy fancy. We further realize that we stand in danger of thy condemnation for having secured too many orders, but we feel that

CUTTING SPEEDS IN CAST IRON

STANDARD ¾-INCH TOOL

DEPTH OF CUT IN INCHES	FEED IN INCHES	CUTTING SPEED, IN FEET PER MINUTE FOR A TOOL WHICH IS TO LAST 1 HOUR AND 30 MINUTES BEFORE REGRINDING		
		SOFT CAST IRON	MEDIUM CAST IRON	HARD CAST IRON
3/32	1/64	222	111	65.0
	1/32	169	84.3	49.2
	1/16	120	59.8	34.9
	3/32	97.0	48.5	28.3
	1/8	83.4	41.7	24.4
	3/16	66.4	33.2	19.4
1/8	1/64	203	102	59.3
	1/32	156	78.2	45.6
	1/16	110	55.0	32.0
	3/32	88.8	44.4	25.9
	1/8	76.2	38.1	22.3
	3/16	60.9	30.4	17.8
3/16	1/64	181	90.6	52.9
	1/32	137	68.5	40.0
	1/16	97.7	48.9	28.5
	3/32	78.0	39.0	22.8
	1/8	67.5	33.7	19.7
	3/16	54.2	27.1	15.8
1/4	1/64	167	83.6	48.8
	1/32	126	63.2	36.9
	1/16	90.8	45.4	26.3
	3/32	72.7	36.3	21.2
	1/8	62.7	31.3	18.3
3/8	1/64	150	75.0	43.8
	1/32	113	56.7	33.1
	1/16	81.0	40.5	23.6
	3/32	65.5	32.7	19.1

STANDARD ⅞-INCH TOOL

DEPTH OF CUT IN INCHES	FEED IN INCHES	CUTTING SPEED IN FEET PER MINUTE FOR A TOOL WHICH IS TO LAST 1 HOUR AND 30 MINUTES BEFORE REGRINDING		
		SOFT CAST IRON	MEDIUM CAST IRON	HARD CAST IRON
3/32	1/64	220	110	64.2
	1/32	169	84.6	49.4
	1/16	122	61.2	35.7
	3/32	99.8	49.9	29.1
	1/8	86.4	43.2	25.2
	3/16	70.1	35.1	20.5
1/8	1/64	202	101	58.9
	1/32	156	77.8	45.4
	1/16	112	56.2	32.8
	3/32	91.8	45.9	26.8
	1/8	79.3	39.7	23.2
	3/16	64.3	32.2	18.8
3/16	1/64	178	89.0	52.0
	1/32	137	68.6	40.1
	1/16	99.4	49.7	29.0
	3/32	81.0	40.5	23.7
	1/8	70.1	35.0	20.5
	3/16	56.8	28.4	16.6
1/4	1/64	163	81.5	47.7
	1/32	126	62.9	36.7
	1/16	90.8	45.4	26.5
	3/32	74.1	37.0	21.6
	1/8	64.1	32.0	18.7
	3/16	52.0	26.0	15.2
3/8	1/64	144	71.8	41.9
	1/32	111	55.4	32.3
	1/16	80.0	40.0	23.4
	3/32	65.3	32.6	19.1
	1/8	56.4	28.2	16.5
	3/16	45.8	22.9	13.4
1/2	1/64	135	67.5	39.4
	1/32	104	52.1	30.4
	1/16	75.2	37.6	22.0
	3/32	61.4	30.7	17.9
	1/8	43.1	21.6	12.6

you should overlook our breach of discipline, because we acquired our order-getting habit when thou didst command that we send thee more business.

"This was during the great order famine when thy power was in danger. We were faithful then and didst have thy approbation and encouragement, but now that thou hast reached this zenith of thy power and glory, it darkens our heart to feel that thou has abandoned us to the mercy of our clamoring customers.

"Now, Oh Factory: We pray thee 'to sit up and take notice' of our deplorable conditions and grant us the blessings of a little bit better deliveries of our prayers for some of thy products, which we have hoped for during the past several moons.

"Now, Oh Mighty Producer, if thou wilt but answer our prayer we will grant to thee all the glory and will shout thy high praises throughout the land."

DEPTH OF CUT IN INCHES	FEED IN INCHES	CUTTING SPEED IN FEET PER MINUTE FOR A TOOL WHICH IS TO LAST 1 HOUR AND 30 MINUTES BEFORE REGRINDING		
		SOFT CAST IRON	MEDIUM CAST IRON	HARD CAST IRON
3/32	1/64	226	113	66.0
	1/32	177	88.4	51.6
	1/16	130	64.8	37.8
	3/32	107	53.5	31.2
	1/8	92.8	46.4	27.1
	3/16	75.7	37.8	22.1
1/8	1/64	205	102	59.8
	1/32	160	85.1	46.8
	1/16	118	58.8	34.3
	3/32	97.0	48.5	23.3
	1/8	84.2	42.1	24.6
	3/16	68.6	34.3	20.0
3/16	1/64	181	90.6	52.9
	1/32	142	70.8	41.3
	1/16	104	51.9	30.3
	3/32	85.8	42.9	25.0
	1/8	74.3	37.2	21.7
	3/16	60.6	30.3	17.7
1/4	1/64	165	82.3	48.1
	1/32	129	64.4	37.5
	1/16	94.3	47.1	27.5
	3/32	77.8	38.9	22.7
	1/8	67.5	33.7	19.7
	3/16	55.0	27.5	16.1
3/8	1/64	143	71.5	41.8
	1/32	112	56.0	32.6
	1/16	81.9	41.0	23.9
	3/32	67.6	33.8	19.7
	1/8	58.6	29.3	17.1
	3/16	57.5	28.7	16.8
1/2	1/64	132	66.2	38.6
	1/32	104	51.6	30.2
	1/16	75.8	37.9	22.1
	3/32	62.6	31.3	18.3
	1/8	54.2	27.1	15.8
	3/16	44.2	22.1	12.9

STANDARD 1-INCH TOOL

DEPTH OF CUT IN INCHES	FEED IN INCHES	CUTTING SPEED IN FEET PER MINUTE FOR A TOOL WHICH IS TO LAST 1 HOUR AND 30 MINUTES BEFORE REGRINDING		
		SOFT CAST IRON	MEDIUM CAST IRON	HARD CAST IRON
3/32	1/64	239	119.6	69.8
	1/32	191	95.3	55.6
	1/16	142	70.8	41.3
	3/32	118	59.1	34.4
	1/8	103	51.7	30.2
	3/16	85.0	42.5	24.8
1/8	1/64	216	108	63.1
	1/32	172	86.2	50.3
	1/16	128	64.0	37.3
	3/32	107	53.4	31.2
	1/8	93.4	46.7	27.3
	3/16	76.8	38.4	22.4
3/16	1/64	187	93.5	54.6
	1/32	149	74.6	43.6
	1/16	111	55.5	32.7
	3/32	92.5	46.3	27.0
	1/8	73.1	36.5	21.3
	3/16	66.4	33.2	19.4
1/4	1/64	168	84.1	49.1
	1/32	134	67.2	39.2
	1/16	99.8	49.9	29.1
	3/32	83.2	41.6	24.3
	1/8	72.6	36.3	21.2
	3/16	59.7	29.8	17.4
3/8	1/64	144	71.8	41.9
	1/32	115	57.3	33.4
	1/16	85.1	[illegible].6	24.8
	3/32	70.9	35.5	20.7
	1/8	62.0	31.0	18.1
	3/16	51.0	25.5	14.9
1/2	1/64	131	55.6	38.3
	1/32	105	52.3	30.5
	1/16	77.6	38.8	22.7
	3/32	64.7	32.4	18.9
	1/8	56.6	28.3	16.5
	3/16	46.5	23.3	13.6
3/4	1/64	112	56.0	32.7
	1/32	89.2	44.6	26.0
	1/16	66.2	33.1	19.3
	3/32	55.2	27.6	16.1
	1/8	48.3	24.2	14.1
	3/16	39.7	19.8	11.6

STANDARD 1¼-INCH TOOL

CUTTING SPEEDS IN CAST IRON

The notoriously high charges that have been made for automobile repairs by the garages are reacting and many of them are now complaining of little work and a much smaller income. Repairs are either being made by the drivers, where they are mechanics, or at regular repair shops, where the charges depend on the work done and not on the owner's position in the list of the "400." Looks like a confirmation of the old adage about honesty being the best policy.

CORRESPONDENCE

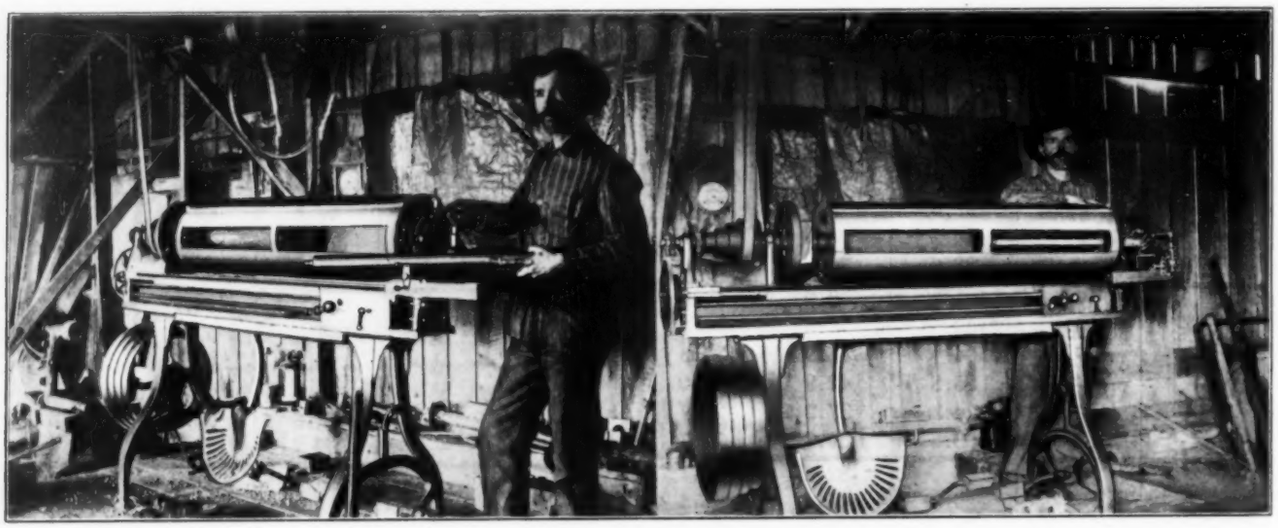
Discussing Phases of Machine Design and Construction

A Long Job on a Short Lathe

You have published from time to time articles on doing large jobs on small lathes, but so far I have not seen any long jobs on short lathes.

Figs. 1 and 2 show the job, and the lathe upon which it was done. The job is a printing-press cylinder 4 feet 7/8 inch long, and 12 3/8 inches diameter. It has a journal at each end, one 7 inches long and one 8 inches long. The 8-inch journal broke close to the head. Several mechanics saw the job and said it could not be repaired in our town, although there was a lathe two feet longer than mine in another local shop. However, in spite of what they said, I tackled it.

I first made a ring like *A* with four bolt holes in it for the bolts *B*. These were used to clamp it to the roll *C*, the nuts being placed on the inside of the ring, of course. Another ring was made a running fit for the outside of the ring *A*. This was secured in the steady rest. The carriage was disconnected from its proper position with relation to the apron, and run along the bed so that it overhung the bed somewhat, and then the end of the carriage nearest the headstock was fastened to the tailstock end of the apron by a cap screw. The end head of the roll was then bored 2 3/8 inches diameter, and threaded 8 per inch. The center-head was bored 1 inch diameter.



FIGS. 1 AND 2. THE START AND FINISH OF THE PRESS-REPAIR JOB

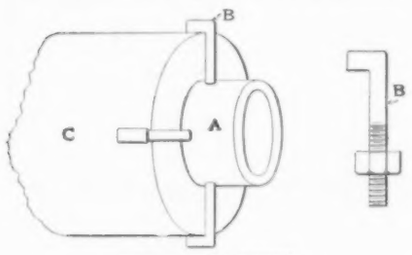


FIG. 3. THE SPIDER

The new steel shaft had previously been turned 1 inch diameter on the end to fit the hole in the center head, and threaded to fit the 2 3/8-inch threaded hole in the end head. This is shown on the carriage in Fig. 1. After the shaft was screwed in place, the journal was turned, which finished the job. JAS. C. CRITHFIELD.

Tempering Steel with Cyanide

I have been very much interested in the articles appearing recently on the subject of hardening Novo steel, and I agree with Mr. Ashley that in *some cases* cyanide can be used to advantage, although I think the method he describes at page 216, Vol. 29, Part 2, can be improved upon.

In case-hardening small pieces a pot may be used to hold the molten cyanide. A number of pieces may be put at one time into a basket made of iron wire netting of suitable size to retain enough stiffness while hot to properly support the work while it is being taken out of the pot to dip in the bath. Galvanized baskets, or those containing any solder at the joints, should not be used. The best results are obtained by keeping the molten mass at a boiling point. At any lower temperature the cyanide does not penetrate so deep; and at any higher temperature the cyanide simply burns away, without the effect being any greater on the work. The work should be allowed to remain submerged in the cyanide pot for at least 5 minutes before being dipped. Of course, this method gives superficial results only, and is generally employed on small articles which quickly heat and which require a surface hardness.

In regard to jig bushings, I prefer to make them of a good grade of steel hardened in salt water, and put in a little extra time in lapping out the hole to the desired size, for when it is finished naturally it will resist wear and retain its size longer than one treated with cyanide and oil. I will admit that in some cases hardening tool steel in cyanide and oil preserves the size and form, but we also sacrifice the hardness to a great extent.

In no way does cyanide affect the life of Novo steel, but it does add to the heavy scale, resulting from the intense heat to which it is subjected for its proper hardening. The two main points to look after in the successful hardening of fine tools made of Novo are, not to overheat, and to use a bath for cooling so that when the steel is plunged into it the absorption of the heat is not so rapid as to cause trouble.

In heating this steel for best results a

gas fire should be used, arranged to protect the work from the air as much as possible, at the same time allowing the operator a good view of his work at all times. The steel will harden nicely between 2350 and 2450 degrees Fahrenheit. Any good oil should be used; it should be thin and not gummy or heavy; fish oil is good and comparatively inexpensive. The work after being hardened should have a grayish white appearance. The strains should be removed immediately. The work can be drawn to suit the user. My personal experience has been that, in all cases, tools with cutting edges, should be drawn to a light straw.

We find that the best way of keeping track of various brands of steel is to paint each bar of each brand a certain color the entire length of the bar, having a different color for each brand. Two charts should be made of the different colors used, with the name of the brand and "temper" opposite the proper color, and one of these charts should be framed for the smith shop, and one for the tool room. Have a handy steel rack, and insist on having the steel kept there. E. S. WHEELER.

The article at page 29, relating to the use of cyanide in hardening steel, was very interesting to me, as I have had a similar experience.

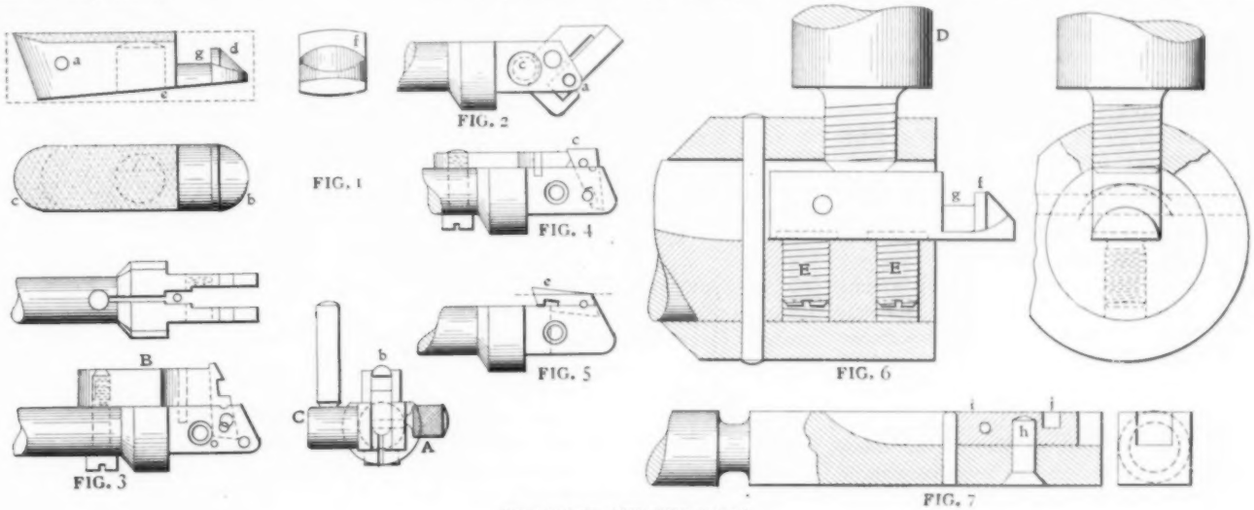
were obtained by using "Crescent special steel" 1.40 carbon, and heating the dies in the following solution and dipping in salt water: 1 pound prussiate of potash; 3 pounds common salt; 2 ounces borax; 2 ounces cyanide of potash. Use a wrought-iron vessel to melt the above. I drew the temper enough to start the color.

This formula was given to me by an old button-tool maker, who told me that it was called King's process, and that he always used it on dies that were used on tin, and always with success. It certainly helped me. Dies that, hardened in the ordinary way, would last from two to three days, when hardened as described would last six, seven, and sometimes ten days. As prussiate of potash and cyanide of potash are chemically the same, except that cyanide is a refined article having the iron taken out, I think in all probability that the combination of the two was a mere whim of the originator.

COMMON SENSE.

Machining an Awkward Piece of Work

Fig. 1 gives three views of a small piece of work calling for quite a number of operations in its manufacture. It was about ⅜ inch long and made of ⅛-inch square mild



THE WORK AND THE TOOLS

Several years ago I was employed in a factory, manufacturing miscellaneous articles of brass, copper, tin, etc. Among the lot were some tin shells or cups, used in making tin buttons. These cups were about ¾ inch diameter by 5/32 inch deep, and were drawn on a double-acting power press, fitted with a set of gang tools, with 16 dies in the set. The tin wore the dies out very quickly, and it got to a point where it was a question of getting a steel that would harden enough to stand the work, or get out of the business. I tried various ways of hardening, and different makes of steel, and different carbons, with varying success. After considerable experimenting I found that the best results

steel. Not having a million to make, and yet enough to require a few tools, I made a general utility fixture for most of the operations and held this tool in the bench-lathe milling device described at page 387.

The work was held in the manner shown in Fig. 2 for drilling hole *a*, and then set in the fixture as shown more clearly in Fig. 3 for taking cut *b*, a pin *A* pushed through the hole, and a block *B* locating the piece accurately. The device was split, as indicated in the sketches, and spring tempered for clamping, the clamp screw being shown at *C*.

The shank was held in the slide-rest milling fixture mentioned before.

Fig. 4 shows the way the piece was set for milling the curve *e*; and surface *d* was attended to in a like manner. The work was held as in Fig. 5 for milling surface *e*. The arcs *f* and *g* were turned in the bench lathe, the piece being held in a simple chuck, Fig. 6, made of drill rod with a slot milled in it, and carrying a collar *D* with a binding screw. The two screws *E E* were to allow for different centers for the arcs *f* and *g*.

It was made a point to get all the locations so far as possible from hole *a* in performing the different operations.

Fig. 7 is a separate jig for drilling the spring hole *h*, the work resting with its face *i* on the drill-press table. The cut at *j* was originally milled, but the turning in the fixture Fig. 6 displaced this operation.

F. J. LECARD.

Estimating by the Toolmaker

In reply to the inquiry regarding this subject, at page 773, Vol. 29, Part 2, I would say that, having tried it thoroughly, I have found that this is practically impossible, for the following reasons: At the present time there are toolmakers and toolmakers. A-1 men, able to estimate intelligently, are as scarce as hens' teeth, almost all such men holding responsible positions as foremen, etc., and not being found at the bench. I submitted several times the same job to different men, and the results were absolutely preposterous—some giving the figures entirely too low, others going still further in the opposite direction and giving a figure which would be prohibitive. Very seldom did anyone come anywhere near the real cost.

In our business we build all the molds for our plastic work in our own toolroom, charging the cost of the mold to the customer in almost every case, and therefore we had to submit an estimate of the cost of them to the customers before making the molds or securing the order. The making of these molds always requires several small tools to be made, the work to be molded and pressed being of such

great variety, and the cost of the molds includes these tools.

In starting an order for a new tool after drawings are made, I make a minute estimate of every detail and operation, and then request an estimate from our toolroom foreman, leaving him in ignorance of my own estimate. We ordinarily come within a reasonable margin of difference, and then discuss the subject and fix a price. Generally we stay within this estimate, except sometimes when unforeseen things happen, which is likely to occur in any toolroom, such as, in our case, defective material, damaging hubs or dies under the hydraulic press, and several other minor causes, familiar to all toolmakers.

Some years ago, when I was a toolroom foreman, the scheme was tried by the management against my advice, with almost disastrous results to the accuracy and workmanship on jigs and fixtures, our requirements being a test by the tool inspector for limits in locating drill bushings and finished surfaces of 0.0001, and plug fits for all bushings ground and lapped.

Another reason is that very few toolrooms, if any, are equipped in such a manner as to make it possible to avoid delays and accidents, and inaccuracy of machine tools. In many instances these machine tools are fit subjects for the scrap-pile, and yet the owner or manager considers his toolroom finely equipped.

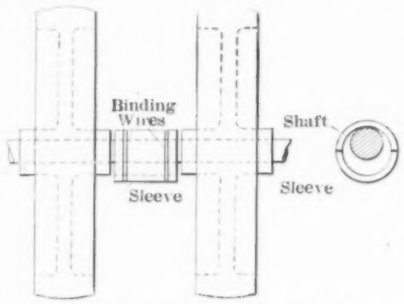
Even in some of the largest toolrooms where I have worked no attempt has ever been made, to my knowledge, to require an estimate from the individual toolmaker—the more so as in these large toolrooms the work is specialized, with lathe, milling, grinding, planing, bench, tempering and other departments.

I would like, however, to see this subject under discussion by other readers, and have no doubt that my experience will be found universal among *toolmakers* (not would-be's). L. C. F. GEORGE.

At page 773, Vol. 29, Part 2, you asked if any of the readers had used the plan of getting estimates from toolmakers. I have in a small way, and have only words of praise for the plan, as I was more than pleased with the interest shown. The toolmaker will not only take great pride in giving a reasonable estimate, but will use his best efforts to complete the work at the estimate given. L. E. SUMMERS.

To Prevent Belts Being Worn when Hanging on Running Shafts

In the shop where I am employed there are about 30 testing stands for testing machines before leaving the factory. The machines are driven by belts running on pulleys on a long line shaft. When no machines were being tested the driving belts were thrown off and hung on the line shaft from one to five hours. The constant friction soon cut through the belting; and to overcome the wear on the belts, wood sleeves made from pulley bushings were put on the line shaft between the driving pulleys. On these the belts rested when thrown off the pulley.



WOOD SLEEVES FOR BELTS TO HANG ON

The sleeves remained still while the shaft rotated inside.

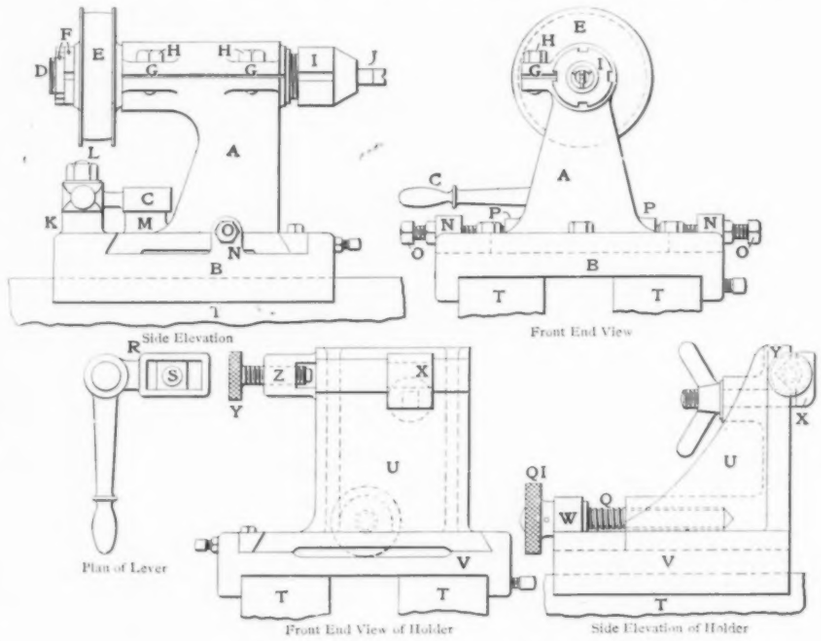
The construction is simple: two ½ wood bushings about ⅜ inch or ½ inch larger than the shaft diameter are put on the shaft and held together with a binding of soft wire. It beats all the hooks and other appliances that I have yet seen.

TEST ROOM.

Machine for Cutting Small Keyways

The sketches show an accelerated speed device for cutting small cotter holes and keyways in valves for petrol motors, small shafts, etc. It is run at a very high speed and is much quicker than a heavier machine, and can be operated by a boy. It will cut keyways up to .3/16 inch wide by 1 inch long.

A is a gray-iron casting, planed accurately on the bottom to slide in *B*, which is clamped on *T T*, two planed channels, and bored out in the top to receive the spindle *D*, on which is keyed the driving pulley *E*. *F F* are two adjusting lock nuts to take up the end play. *G G* are two lugs, drilled and tapped to receive ⅜-inch setscrews *H H*, which adjust the bearing, to compensate for wear on the spindle. These tighten on to a fiber strip, ⅛ inch thick, shown inserted in the milled groove along the center, after the casting is bored. *I* is the chuck for gripping the cutter *J*; *C* is a bell cranked lever as shown in the plan, with a slot machined in the end, in which the square block *R* is a nice sliding fit, and bored out to receive the pin *S*. *K* is a boss cast solid on *B* to support the fulcrum pin *L* on which the lever *C* fits. When the operator moves the lever, it moves to *A* through the pin *S*. *N N* are two lugs, tapped out for the adjusting screws *o*, which determine the length of the stroke, and also the keyway to be cut, by coming



MACHINE FOR CUTTING SMALL KEYWAYS

in contact with the two bosses *P*, which have machined ends.

HOLDING THE WORK

The work holder *U* is a gray-iron casting planed to work in the slide *V*, which is clamped on the channels *T T*, and has a boss cast on the back to receive the feed screw *Q*, held in the lug *W*, as shown in the side elevation of the holder. This has a V-groove planed at the top, exactly the same hight as the center of the spindle *D*, and the work is secured in this by the hook bolt *X*, which also has a V planed to 120 degrees, as shown by the dotted lines. The bolt passes through the boss

cast on *U*, and has a wing nut on the back which is quite sufficient to secure any work within the capacity of the machine. *Y* is an adjusting screw with a nurled head for bringing up against the work and adjusting it to position endways. *Z* is a boss cast on *U* for supporting *Y*, cored out at the end next to the *V* as shown.

When the boy is operating the machine he holds the lever *C* in his left hand, and feeds the work up to the cutter with his right hand, operating the square-threaded screw *Q* with the nurled end *Q I*, as shown.

We find it profitable to keep two of these machines continually at work on small keyways and cotter holes, and they have effected a considerable saving of time as compared with ordinary slot drills, which cost far more money. TRIPLE AUTO.

England.

Making an Index Plate

Take a sheet of zinc, such as is used under stoves, 32 inches square, and make it as flat as possible. Sometimes, in the hardware stores, round zincs, mounted on wood of suitable diameter, can be found. Draw a circle 30 inches in diameter, and divide with trammel points into six equal parts; then with dividers divide each space into ten parts, and each of these into six smaller divisions, giving 360.

The arm *B*, Fig 1, is made of hard wood 1½ inches wide by ½ inch thick, and about 17 inches long, and on the center end is a

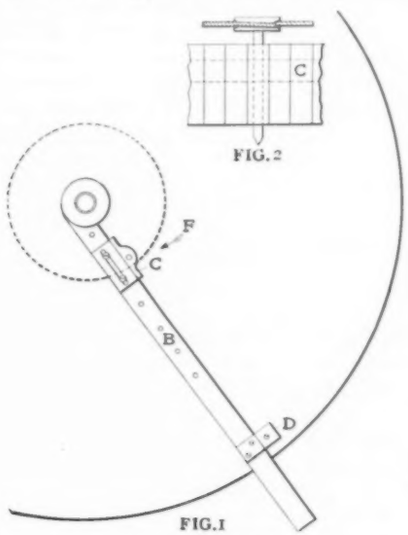


FIG. 2

FIG. 1

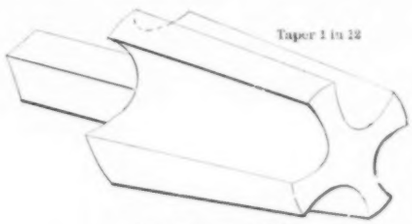
DIVIDING AN INDEX PLATE

brass plate carefully placed in the exact center of the circle. On the arm at *D* is a plate through which passes a steel pointer with a sharp point that can be put into each division. The part *C* is mounted on the arm at a proper position, and held by two round-headed screws, as shown. Fig. 2 is a view of the part *C* seen in the direction of arrow *F*, Fig. 1. In *C* is placed a drill with a pulley on the top, and a suitably shaped drill point on the bottom end. The drill is worked with a bow, and gut cord, such as old-time matchmakers used to run their bow lathes.

The plate to be divided is shown by the small circle in Fig. 1. After being divided, the large circle should be marked at each division with a sharp, small prick punch, so that the pointer in *D* can be easily and exactly placed therein. INDEX.

Relative Efficiency of Boiler Tubes

"Engineering Reminiscences," at page 830, tell of an engineer who, to ascertain



BOILER-TUBE PLUG

which of the tubes in a boiler under his charge were efficient, inserted pieces of wood in each tube, finding in this manner that a good percentage were valueless to raise steam.

Reading this reminded me of an identical experiment of which I was told by the chief of a steamer, who had it carried out. The boilers were well up to their work, but after ascertaining the consumption of coal per horse-power hour, he came to the conclusion that it was too high. As the boat was new and he desired to please the powers that were, he tried several expedients.

The experiment described by Mr. Porter was among them. As a practical man the engineer was struck by the disproportion of value existing between tube and tube. Plotting the results obtained, he informed me that the arrangement of the more efficient tubes suggested a truncated triangle. Not content with simply obtaining these results he adopted a remedy, which was to partly stop the tubes carrying the most heat at the front or smoke-box end. To do this he had a number of tube plugs cast as shown in the sketch. He inserted these plugs in the tubes, and by securing a better distribution of heat obtained an increased economy.

Experience has shown me that with some boilers a gain in economy is marked after a day or two's steaming, when some tubes are partly choked. To check this fact entails considerable labor, in weighing coal out for use several times on a run and taking cards at the time the weighed coal is used.

The distribution of the tubes to increase their effectiveness would seem to be a question that can only be settled by scientific experiment; and a clear case for experiments of this character by one of the technical schools is made out, and the results obtained should be of value.

A. L. HAAS.

A Tool for Shading Circles

The accompanying sketches show a draftsman's tool for shading circles and a sample of its work.

Often the draftsman has to strike a number of different sized circles from the same center, all of which need to be shaded. To do this he generally uses two centers which, after being used a few times, are both much larger than they should be to strike good circles from, if not spoiled by being crowded into each other.

The circles shown in Fig. 2 illustrate the application and the original shows also what a neat and accurate center can be kept when using this tool. It is much more convenient to use this than to make the second center, even if only one circle is drawn, and when making a tracing no chances are run of getting the divider point in the wrong center.

Fig. 1 shows the tool full size. The joint is made with a slight friction that the legs may be adjusted easily but be firm enough to stay in place when in use. The point in the lower leg is placed in the center hole and the hole in the upper leg,

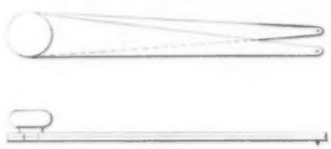


FIG. 1

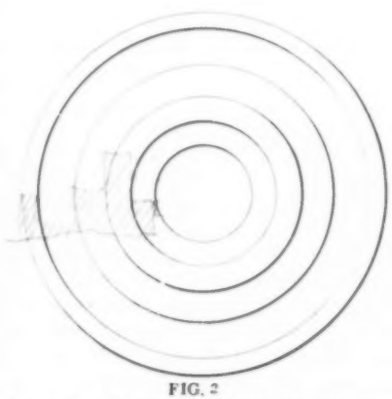


FIG. 2

A TOOL FOR SHADING CIRCLES AND ITS WORK

properly set to the desired throw, is used as a false center for the divider leg while a half circle is struck. M. H. BALL.

Double-ended Cutters

In reading the article by Common Sense, page 544, Vol. 29, Part 2, I got the impression he had some trouble in turning his cutters, or perhaps it took longer than

he liked. I have made many double-end cutters, and always made them as Common Sense has recommended in his article; but I never turned them, if I could get them into the grinding machine, which I nearly always could, for our grinder would take six feet between centers. With the bar on centers, without a dog, and with a coarse emery wheel, I could grind the cutters down in a very small part of the time it would take to turn them.

JAMES EATON.

A Compact Tool Chest

I send you a design of a tool chest for machinists and tool-makers, which I find to be the best chest for use in a fine machine shop, as it takes little or no bench room. The body is made of ½-inch boards. The lid marked *B* is cut on an angle and hinged in the center of the top, like the design. The cover marked *A* is hung on hinges inside of the lid *B*, giving a space between *A* and the inside of the lid *B*, and on the inside of *A* for calipers, dividers, or any such tools, to be held under brass clips, and a space in front of *A*, as shown in the design, for scales, straight edges, center gages, and drill gages.

A piece of heavy felt or leather fastened on the face of *A*, as shown in the design, stops the chafing of the tools on the drawers. These can be held in position under small, round-headed, brass screws. The front and the bottom of the drawers, also the backs, are to be made 3/16 inch thick. The ends should not be less than ¼ inch thick, and a groove 3/16x¼ inch should be cut for runways, leaving the space *E* at the bottom for heavy tools such as hammers, monkey wrenches, etc., thus leaving the drawers for other tools.

This chest can be carried by a shawl strap, the design for the handle of which is shown above. This handle can be made of brass or any other metal. This chest, if tools are properly arranged, will hold all that any machinist or tool-maker will require, as there is practically no unused space. I have had one of these in use for two years, and it meets all requirements.

H. F. BENITEZ.

Useful and Useless Mathematics

It's a terrible thing for a man to lose his self esteem. I had an excellent opinion of myself (although no one suspected it) before those articles on cast-iron beams were published, but they nearly convinced me that plain practical knowledge is not impressive enough. However, I have taken heart again since reading John E. Sweet's excellent collection of comments at page 851, Vol. 29, Part 2. (We always think those things excellent which we ourselves would say if we had the ability.)

I am afraid he is a bit of an iconoclast. To read these comments, one would never suspect him of having been professor of practical mechanics, because professors of practical mechanics are as a general thing so very unpractical.

A good many years ago, in the German comic paper *Fliegende Blätter*, there was a picture of a very tall professor of practical mechanics in his night shirt standing in a bedroom of a hotel. He had lain down in that bed for the first time, and found that it was too short by so many centimeters. He then got up, measured the length and breadth of the bed with a pocket tape, squared these two dimensions, extracted the square root of the sum of the two squares and found that he could lie with comfort from corner to corner, or "diagonically," as an Irish laborer of mine used to put it.

"How thick shall I make this flange, Mr. Dixie?"

I know by experience that ¾ inch is all right, but if I say, "Just make it ¾ inch thick," my man thinks I'm a common dub the same as himself. There's nothing impressive about such a statement. If he hasn't got a table of decimal equivalents and is not accustomed to thousandths, I may make it impressive by saying, "Make it seven hundred and fifty thousandths," and then qualify and translate my profound speech for him by adding, "Three-quarters will do if you haven't a micrometer."

My five years old boy asks, "How much is 12 times 12?" "One hundred and forty-two," I reply at once. That is a wonderful stunt to the little chap's mind. There's plenty of mystery for his small brain. He doesn't know by what mental process I arrive at the answer so quickly. He doesn't question the correctness of the answer. He doesn't give that a thought, he is so lost in amazement at and admiration for the rapidity with which I arrive at *an* answer.

Two years later he will ask me the same question and take my answer, 144, down without marveling. There's no mystery about it, he knows my methods; but two years hence if I turn to him and say: "Think of a number, double it, add 288 to it, halve it, take away the number you first thought of and you have 144

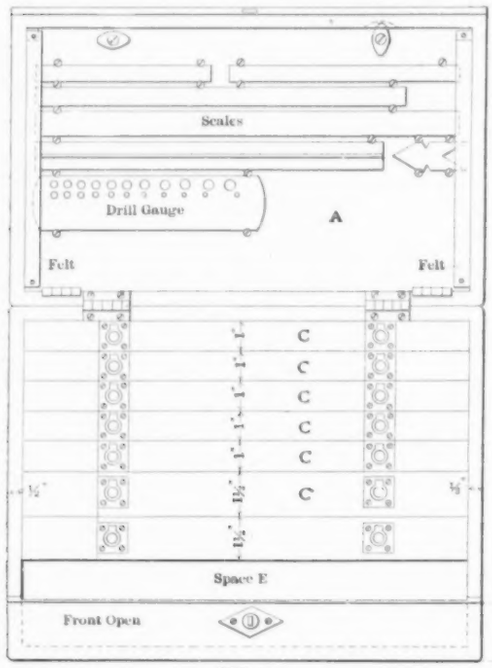


FIG. 1

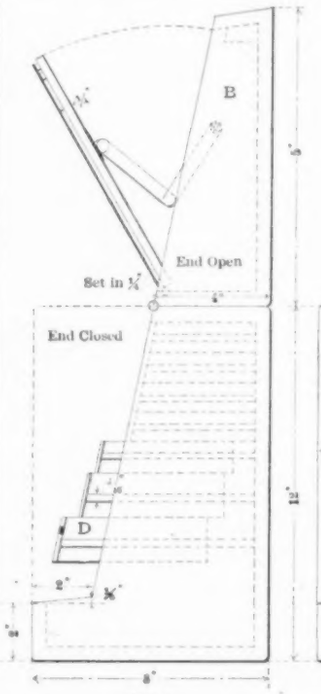


FIG. 2

A COMPACT TOOL CHEST FOR THE BENCH

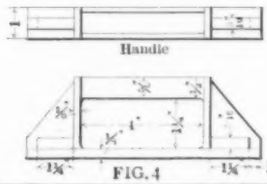


FIG. 4

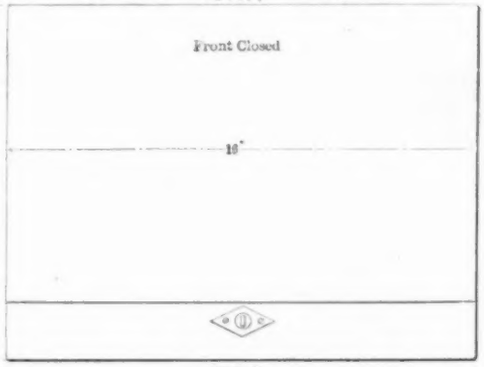


FIG. 3

left," I will have him where these technical people have the rest of us.

I have in my time met quite a number of these technical men. With few exceptions their chief delight is to make their methods mysterious. Real accuracy does not seem to be the prime requisite, but apparent accuracy, secrecy and mystery do. I know men who do not think of one as just plain one, but as something like this:

$$\frac{1 \times 1 \div 1^2}{\sqrt{1}}$$

When they go into a restaurant they are apt to order French fried potatoes and turnips, cut in little dice and creamed, just because of their infatuation for square and cube roots. Men like this are not satisfied with twice two being four. It's the underlying mathematical principle involved that attracts them, though goodness knows it's not half as involved *before* they get hold of it as it is *after*.

Apparent accuracy, of course, they all make a great show of. One man I had working for me insisted upon making two sets of drawings where one would have done—one set for the patternmakers and one set for the machinists. I could never understand why the sizes for cored holes were given to four decimal places. A 9/16-inch hole would be marked on the drawing 0.5625 inch, a moderately difficult job to produce with drill and reamer, and absolutely impossible in a foundry. Is there anything in favor of marking a drawing in this way? I think not; 9/16 inch is easier to write and takes less ink than 0.5625. The average patternmaker knows what 9/16 inch means, but does not know what 0.5625 inch is, without referring to a table of decimal equivalents. Furthermore, the machine work on the machines was moderately rough; except for the working parts a sixteenth more or less didn't signify.

This same man left us and went to work as inspector for a concern for whom we built a lot of machines. We had many a quiet laugh at the ease with which he was cajoled. A special reamer had been made. It was supposed to be 15/16 inch diameter, but it had sprung in the hardening and the tempering under pressure had not brought it quite straight; so that when ground it was two or three thousandths undersize. The cold-rolled shafts to fit the holes made by the reamer had been ordered from the mill, cut to length. They arrived after the holes had all been reamed. The cheapest way out of the mess was to grind the shafts.

While the grinder was being rigged up, our bright inspector came over to me. "Mr. Dixie, is that cold-*rolled* shafting?" Now we got that particular lot of shafting from the "Union Drawn" people; so I replied with my usual strict regard for the truth, "No, that is cold-*drawn* steel."

"Oh, that's all right; we don't want any cold-*rolled* stock in those shafts."

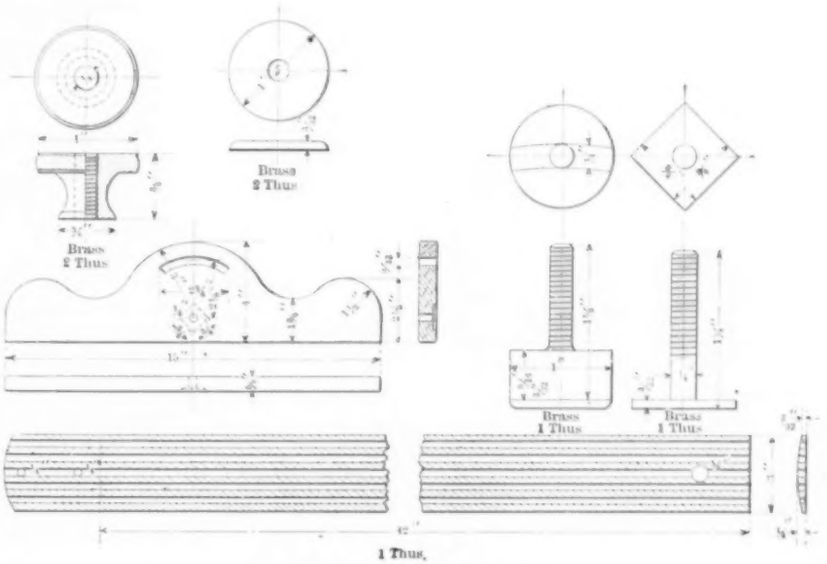
As a matter of fact, sash-weight iron or lead would have done all the work those shafts had to do. When he saw the grinder start on the job of reducing the shafts, he inquired why they were being ground. To which question I replied by asking another, "Did you ever hear of a really accurate cylindrical fit being obtained without grinding?" That settled him, and I heard later that he had reported to his people that Dixie & Yank were putting a lot of fine work on those machines, as all the shafts were being *hardened* and ground. Where he got the "*hardened*" from I don't known, except perhaps out of Brown & Sharpe's catalog.

I asked a man I once worked alongside of (one of those mathematical geniuses who delight in those little $\int$ things such as one sees cut in the bellies of fiddles to let the sound out (and I often think their use by these mathematical geniuses is for the same purpose), what was the total length of a gear tooth one inch pitch. He seized paper and pencil, looked up several formulas and found it after several minutes' figuring to be nearly 1 3/16 inch to five places of decimals. I guessed it to be 11/16 inch, which was considerably nearer than his formulas brought him. He was so dazzled with the glamour of his own figures that he couldn't see that a tooth one inch pitch and 1 3/16 inch long would be sure to bind and interfere. What's the use of such mathematical ability (?) as this if it deadens a man's common sense and blinds him to such very apparent errors? If this man's calculation had gone unchallenged he would not have *seen* his error, would not have gone over his work again; and, if it had been possible to cut gears one inch pitch and 1 3/16 deep, who can tell what useless expense might have been incurred?

As an apprentice I imagined that the sciences were used to simplify, that they were merely tools, refined tools, the product of refined brains and skill; that mathematics bore the same relation to arithmetic that arithmetic does to counting on the fingers—the same relation that the planer and shaper bear to the chipping chisel backed up by brute force and sanguinary ignorance. I thought the use of mathematics simplified work; but now I am sure that one must handle them with skill the same as one handles any other tool, and that a job of mathematics can have as bad a wind in it as a planer job, if it is not skilfully handled. DIXIE.

A Tee Square

Oftentimes there have appeared in your paper articles and sketches on drafting-room appliances, but as yet I have seen nothing relating to a tee square, and as I have been using one that I think is just about right, I hand you herewith a sketch of it. It is somewhat different from the ordinary tee square used in drawing rooms throughout the country, in the way the head is attached to the blade, and in the way the blade itself is constructed.



DETAILS FOR A 42-INCH T-SQUARE

It was originally intended to order 12 tee squares of the same pattern, and the 12 sandwich plates were all cut from one block, made by arranging first a layer of kiln-dried maple and then one of mahogany, and building so on up, until the desired number of layers was obtained. Each layer was thoroughly coated on both sides with glue before the next one was laid upon it. It was then placed in a veneer press and dried in the same manner as veneered boards; after which it was sawed into boards the thickness of the blades required and the top rounded to the dimensions given. If uniformity throughout is desired, the tee-square heads may also be sawed from built-up sections made in the same manner as the blades. We made part of ours each way. The object of building, especially the blades, in this way

was to overcome the great trouble experienced in steam-heated offices, viz., keeping the tee square in line, and to prevent its warping out of shape.

At first glance this tee square may seem a trifle heavy and expensive; but anyone who has used a square of this kind will readily agree that its weight is in its favor, while its durability when compared with the ordinary square will more than make up the difference in first cost.

E. W. Bowen.

Cutting Spiral Oil Grooves in Shafts —How a Lathe was Geared for Cutting Coarse Leads

Some years ago, when I was connected with a firm building planers, we had a job of cutting spiral oil grooves in the planer shafts, and as we had no other means of doing the work I decided to have it done on a lathe. It was not geared up to cut leads coarser than one thread per inch, and I wanted to cut one thread in six inches; so I devised the method shown in Fig. 1, which explains itself.

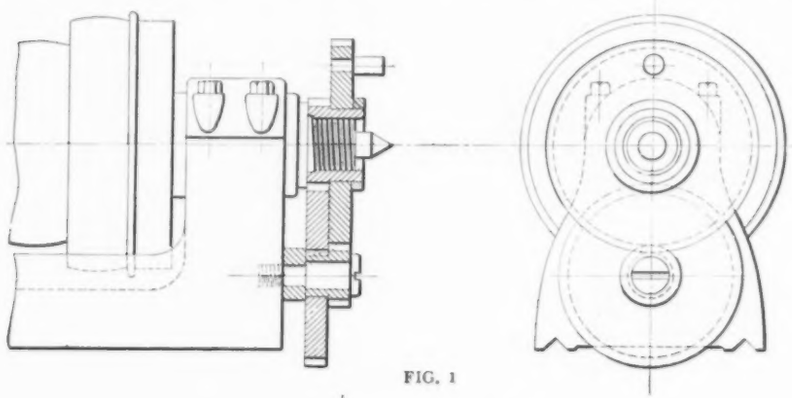


FIG. 1

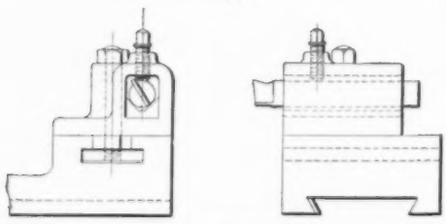


FIG. 2

CUTTING SPIRAL OIL GROOVES IN SHAFTS

The gears were so arranged that, when the gear that has the carrier made one revolution, the lathe spindle made six, and by gearing up the lathe for one thread per inch I was able to cut the required spiral. This arrangement was very satisfactory, as it did not put any extra strain on the lead screw and change gears, as it would have done had I made special large change gears.

As such coarse pitches have very steep angles and vary for different diameters, I designed the tool shown in Fig. 2, which can be twisted around to suit different angles and can also be used for cutting either right- or left-hand spirals.

Cincinnatus.

The Specialist versus the All-around Man

The criticism at page 640 of my article at page 515, Vol. 29, Part 2, has suggested a few more points which might be considered. Pessimist, at page 643, says: "The American Machinist makes of us one great mechanical family exchanging opinions and ideas for the advancement of the line on which we are working," which is my excuse. Both my critics seem to have misunderstood me somewhat, as they seem to refuse "specialists" credit for any ambition.

MEANING OF SPECIALIST

I certainly said I meant to stick to the old shop, but not necessarily as a lathe hand; also, I think Con Wise took the word specialist in too narrow a sense. By a specialist I mean a turner, a fitter, or a man expert in any particular branch of the trade, and the whole of that branch. I think my critics are both Americans, and I believe shop conditions are quite different on their side of the streak from what they are on this. I hope to see for myself some day.

First of all, I do not admit for one moment that specialism requires less "mental and physical efficiency, and that more pay is to be got for less work." Has Mr. Yeomans ever tried it, or is his only a scientific theory?

In the first-class shops nowadays the time on all except repair jobs is known to a hair's breadth, and if a man cannot make balance he soon finds himself on the street, for he has no excuse unless on a new job. On the other hand, in all-around shops doing all sorts of work the time cannot possibly be known, and there is often a good excuse for a shackle.

I think Mr. Yeomans gives himself away when he says all-around men are not employed nowadays. I quite agree with him, for that is exactly what I tried to point out before; but at the end of his letter he advises the specialist to try and become an all-around man. He also says business faculties are required in the higher branches; but it appears to me to be decidedly bad business to stock a shop with a lot of stuff there is no market for; marketable product of the best possible quality is what is wanted now, and there you have the specialist.

OBJECTIONS TO MOVING AROUND

If a man moves about a lot at the beginning of his career he has really only a smattering of a lot of things; he is not skilful enough at anything to earn a decent wage till he becomes a specialist. He is bound to come to that some time, and it may as well be soon as last. Then again, if he is moving he can't possibly do much studying; he is too worried to give his mind to it; he never knows his job is safe, for he is always a fresh man, and consequently is never given jobs of any importance, and he is perhaps out for weeks or months at a time. Of course it is all right if his people have a table he can go to without feeling himself a cad; but how many of us machinists are so happily placed? No amount of grit will get a man a job if employers do not want him, and meanwhile how is his study getting on? And if he cannot study, how can he obtain information? Suppose a lathe hand is made a foreman, as Con Wise admits he may be. If it is a small shop, he has, ten to one, been in long enough to learn most of the jobs; and perhaps Con Wise will give a man, smart enough to be made a foreman, credit for a little common sense to tide him over the difficulties he meets. If it is a large shop, he has only lathes to look after, and he is quite at home and can learn as he goes on.

THE LINE OF PROMOTION

I think the chances are that if a man does not get a start in authority from a man who knows and trusts him, he will never get one from a stranger. Machinists do not often go straight from lathe or bench in one shop to walking jobs in another; for nowadays there are so many foremen who have experience in controlling men looking for jobs that the common or garden machinist has not a ghost of a chance.

I say nothing about the higher stages—time enough to think about them when the machinist has the first step off his mind. Mr. Yeomans says the specialists are out of the line of promotion. May I ask if they promote millwrights or men working as all-around men? Or would

an all-around man be likely to go from a workman's place in an all-around shop to a foreman's job in a tool works? I think he would not; he might be made foreman of his own shop, but he would be no better off than the specialist who has charge of a section; for the specialist is the better paid and his job is not so trying. What a man learns in small all-around shops is how to go around the longest way for the shortest.

I will admit that when once a specialist gets into a groove it is pretty well all up with him; but I tried to point out previously that he need not get in one at all. Con Wise seems to be rather annoyed that I should work for nothing but wages. I should think he would have jumped at the conclusion that, as I liked them so much, I would be continually striving to get more, instead of being content with a "small wad and plenty of tobacco." Is it because the grapes are sour, or is he one of those obliging fellows who are only too pleased to work all hours of the day and night, and be quite content and happy with a little praise from the boss? Does he work for the honor and glory of being called an engineer? I must confess myself that I do not believe in philanthropy in business. From what I can see it seems to be "everyone for himself and de'il take the hindmost," and if a boss praises me, I ask him for a rise on principle. I find they soon drop it.

THE BUSINESS END

Now, may I make a comparison between the specialist and all-around man as far as business is concerned? Perhaps my critics will admit that it is very seldom a specialist is paid by day's work in large shops, and more seldom that an all-around man is paid by piecework; also, that it is every man's duty while he is in the shop to work as hard as he possibly can. The piece-worker does his work at the employer's valuation and gets paid for it if he does more in a day than his time comes to, which is good business; while the all-around man gets no extra pay whatever he does. If he is a smart man and works to the top notch, he is bound to do more than the value of his time, and if he does not, he is a shackler. I dare say the objection will be made that the all-around man is paid for his services as the foremen are, but the fact remains. Perhaps the honor is an attraction to some, but for myself I would rather have the extra .125 or .5. It is certain the bosses don't give anything away by paying the extra, or they would not look askance at the man who can only make bare time.

As for trusts and monopolies, they are not much in my line, but I should think the man who wants a fair day's wage for a fair day's work is the man the trusts do not like. Anyway, I think Con Wise and I have at least one idea in common—a better position and more pay.

My wise friend says the reason a foreman turns away the man who says he is all around is because he does not believe him. He might have gone a little further and said it is because he knows it to be impossible for an all-around man to come into his shop and go the pace. My previous observation about rushing the foreman out was sarcastic. I point this out for fear I should be accused of contradicting myself.

SPECIALISTS IN DEMAND

He also says the jobs are looking for the men. They are likely to, for the men have found it pays better to be specialists and have therefore gone in for it. I don't wonder Con Wise is worried because there are so many specialists. The worst of it is, the class is becoming bigger and bigger. In my own limited experience I have seen three specialists made foremen and managers, and not one gained promotion by dodging about.

Con Wise finishes up by asking whether I myself, admittedly only a specialist, would hesitate to take charge of an all-around shop. He thinks I would not, for which I thank him; but if I would not, why should any other specialist? By the way, would Con Wise take a foreman's job without more pay? I wouldn't. That is an Irishman's rise over here. I saw in this paper, in the articles on straw boss that a foreman should be able to lick any man on any machine and lick him afterward if necessary. My first foreman was a draftsman, and the second in command a lathe hand, who did not look a formidable opponent for a well developed schoolboy. They ruled 300 men with a rod of iron and were respected as well as men could be. I think the best plan is to keep the fat down by hard work, both mental and physical, take one step at a time and not miss nearby things by looking too far ahead. Then promotion will come both to specialists and all-around men, each in his own particular way.

Thanking Mr. Yeomans for kindly criticism and Con Wise for sympathy, I can still sign myself,

WOULD-BE MASTER OF ONE TRADE.

A Pressure-loaded Hydraulic Accumulator

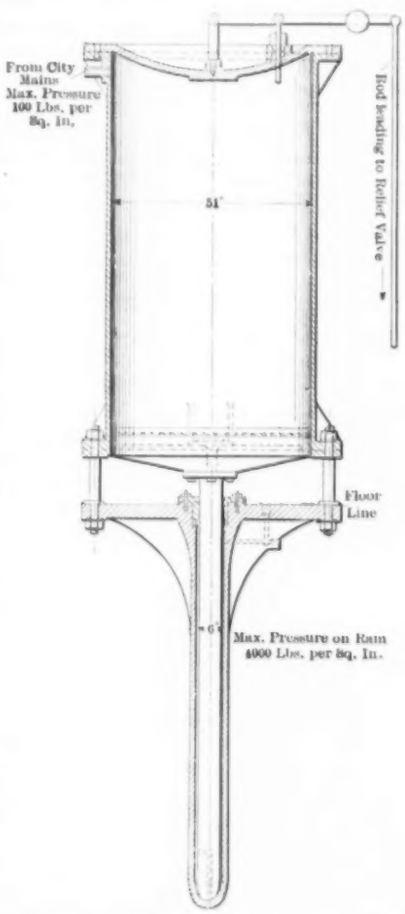
The accompanying sketch, together with a short explanation, may induce some of your readers to give their opinions as to the originality of replacing weights by hydrostatic pressure in hydraulic accumulators. This was done to reduce cost. In the case of a weighted accumulator the weights, at 2¼ cents per pound, would have cost $2542.50, while by replacing the weights by hydrostatic pressure the whole cost, approximately, $1000.

All I judged necessary to get good results was to get static equilibrium between the ram and the piston, and to that effect I tried to get a formula which would take the friction of packing into account. This was done by taking Reuleaux's interpretation of Hick's experiments, which for the force of friction read thus:

$$F = \frac{P \pi D}{4},$$

where P = pressure per unit of area,
D = diameter.

By putting this value of F for the power of both the piston and ram ends of the accumulator, and equating for the diameter of the piston, I got the comparatively simple formula:


From City Mains Max. Pressure 100 Lbs. per Sq. In.
Rod leading to Relief Valve
51"
Floor Line
6"
Max. Pressure on Ram 4000 Lbs. per Sq. In.

A PRESSURE-LOADED HYDRAULIC ACCUMULATOR

$$D = \sqrt{\frac{P}{p} d (d + 1) + \tfrac{1}{4} + \tfrac{1}{2}},$$

where P = pressure on ram
p = pressure on piston
d = diameter of ram
D = diameter of piston.

J. A. G. GOULET.

What is stated to be the largest electro-pneumatic switch-and-signal interlocking installation yet constructed is to be put in the yards of the new railroad station in Washington by the Union Switch and Signal Company. It will be a more complicated plant than those in the Union Station in St. Louis and the South Terminal in Boston, which were made by the same company.

AMERICAN MACHINIST

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Help Wanted

We want to know where there is new, interesting, large, accurate, or unusual work being done—and will pay for the information.

The mechanics of the world have been helped more by the articles on shop practices printed in the AMERICAN MACHINIST, than by any other means. This has been due to the liberality of the American shop owners and our own enterprise.

Now, the country is too large for our editors to know where all the interesting work is going on.

They must look to their readers for help.

Will you help?

We pay for articles, we pay for photographs, we pay for tips as to where interesting work is being done—provided we describe it; and of its availability the editor must, of course, be the judge. Also, of course, we cannot be expected to pay for photographs of machines which are offered for sale.

There is no end of interesting things which must be caught on the fly if they are to be caught at all, and it is only by rare good luck that we come across such things in our going about the country. This is especially true of large work, of emergency work, and of large foundry work. The piece of work which is too large for the nominal capacity of the facilities at hand comes up regularly in all shops, and in none more regularly than in those doing heavy work. Unless someone on the ground when the work is done has the foresight to secure photographs of such work when it is in progress, the opportunity to publish it is lost, and no amount of enterprise on our part can secure more than a very small fraction of the cases of this kind which are in constant progress in the shops of this country. The same remark applies to emergency work of all kinds, and especially to foundry work.

If those in touch with heavy foundry work could be induced to appreciate their opportunities, the result would be reflected in our columns in a manner most gratifying to all concerned. Most large establishments have today a photographic department which makes the taking of pictures easy, and a series of pictures taken every day or every other day at noon of some unusual piece of foundry work in progress would tell a story worth while.

No one knows as well as an editor the hesitation—we had almost said fear—which many people have of appearing in print. To those whose fear is beyond removal an easy solution of their difficulty exists in our editorial staff, which exists for the purpose of preparing just this sort of material for publication. If our readers could be induced to take the photographs and send them in with a few explanatory notes, the rest would take care of itself.

We want articles concerning the making of machinery and tools of any kind, and want to interest and instruct men in charge of the work—men who seek to produce machines better, faster or cheaper.

Send us articles about work.

Send us photographs.

Send us pointers as to where we can find interesting material for publication.

We will send you a check for everything used, tips included, and thank you besides.

We want your coöperation in making this paper better than it ever has been.

Address: Editor, AMERICAN MACHINIST, 505 Pearl street, New York.

Great Britain's Lead in Shipbuilding

Much has been heard during recent years of the competition of German with British shipyards, and of course everybody knows that some of the largest and finest specimens of naval architecture afloat have come from Germany. Those who have imagined from this that Germany is within sight of catching up with Great Britain in the production of ships, as measured by the tonnage output, seem, however, to have little on which to base their conclusion.

Figures for the output of 1906 have already been published, and they show that the tonnage launched in British yards during that year reached the enormous total of 2,000,000 tons, against the previous high-water mark of 1,826,000 tons in 1905 Against this the tonnage launched from German yards reached the comparatively moderate total of 220,389 tons.

With the exception of Great Britain, Germany is far in the lead, the output of Holland having been but 22,714 tons, of Norway, 23,771, and of Denmark, 8080. The total tonnage launched from France is not given, but the large shipyard on the Seine built nine vessels aggregating 6258 tons. The rise of Japan in the shipbuilding industry is shown by her product of five vessels aggregating 11,534 tons.

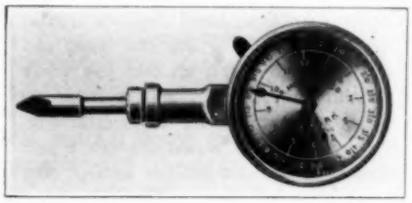
The output of Great Britain has exactly doubled since 1881, albeit, during the intervening years, the output went as low as 473,675 tons in 1886. The increase in size of vessels is not confined to Great Britain, but the largest ship yet launched, is British—the "Mauretania" which has a length of 785 feet with a tonnage of 33,200 which far exceeds the total tonnage launched by any other country except Germany. The comparison of British with other shipbuilding is summed up in the single striking statement that the United Kingdom launches more than twice as much mercantile steam tonnage as the rest of the world put together.

Consul-General Hugh Pitcairn, of Hamburg, reports the application by the German Government of wireless telegraphy to the transmission of time signals to outgoing and incoming vessels.

New Tools and Machine Shop Appliances

A SPEED INDICATOR

The illustration shows a handy little speed indicator which registers up to 1200 revolutions and then repeats. The long hand registers units and tens and the short hand, hundreds. A knob at the back of



A SPEED INDICATOR

the instrument permits it to be quickly set to zero. The small projection from the rim, between 85 and 90, is a trip lever which throws the mechanism in or out of engagement with the registering hands. It makes no difference in which direction the shaft rotates, the hands always turn in the one direction, i.e., the same as those of a clock.

This speed indicator is manufactured by J. R. Hebert Company, 256 St. James place, Brooklyn, N. Y.

New Publications

"Locomotive Performance: The Result of a Series of Researches Conducted by the Engineering Laboratory of Purdue University." By William F. M. Goss, M.S. D.E., Director of the Engineering Laboratory and Dean of the Schools of Engineering, Purdue University. New York, John Wiley & Sons, 1907. 439 pages, 5½x9 inches; 229 illustrations; cloth; price $5.

The distinction which Professor Goss has attained in the development of locomotive testing on exact scientific lines, makes his name on a book treating of this subject a sufficient guarantee of its worth. A large portion of the matter contained in "Locomotive Performance" is familiar to those who have followed the presentation of the researches before various technical societies and in the technical press. It will, however, be a great convenience to have this matter brought together into one volume, even though in some cases somewhat abbreviated; and the addition of some new matter increases the value, making this a very complete record of the work done on the first locomotive testing plant during its 14 years of service. The book gives the whole history of the origin and establishment of the Purdue plant, detailed accounts of the methods of testing followed, with illustrations of the forms employed for keeping the records, and gives descriptions with tabulated and plotted results of a great number of investigations to determine the effect of particular features of design and operation, most of which were experiments with the two locomotives built for Purdue University, though space is also given to some other experiments. The concluding chapter of 15 pages is a "generalization of locomotive performance," and applies the data derived from experiments with the Purdue locomotive to estimates concerning the performance of locomotives in general. It starts by accepting 12 pounds of water per square foot of heating surface per hour as a fair measure of evaporative performance, and derives equations for cylinder horse-power in terms of heating surface, for draw-bar pull, etc., and includes diagrams of draw-bar pull at different speeds for some heavy freight and passenger engines, as compared with those of the smaller Purdue locomotive. The book contains useful information for the designer, but is arranged, not as a text book, but as a record and repository of data.

Joseph Flather

Joseph Flather, president of Flather & Co., Inc., Nashua, N. H., died at his home February 3 of valvular disease of the heart, aggravated by a slight attack of pneumonia. Although he had been in failing health for the past three or four years, his death at this time was unexpected.

Mr. Flather was born in Bradford, England, April 1, 1837, and received his education in the common schools of that city and at Norwich. At the age of 11 he entered the repair shop of a large mill in Norwich and continued there for one year, when he was apprenticed to his uncles, William and Henry Hodgson, manufacturers of worsted machinery at Bradford, and continued in their employ for about five years. At the age of 19, his term of apprenticeship having expired, he, with his father, took passage on a sailing vessel for Philadelphia, where they landed in September, 1856. Being unsuccessful in finding any employment in or around Philadelphia, they made their way to Harper's Ferry, W. Va., where Joseph Flather secured work filing gun-sights at the Government arsenal. Afterward he went to Zanesville, Ohio, to work in a railroad repair shop, but soon returned to Harper's Ferry. In 1859 he went to Nashua, N. H., and entered the employ of Chase & Co., manufacturers of sewing machines. He continued there until the Civil War broke out, when he secured contract work in gun factories in Binghamton and Yonkers, N. Y., Trenton, N. J., and Bridgeport, Conn. While at the latter place he worked on the tools first used for the manufacture of the Henry repeating rifle, the first of its kind used by the Union troops.

At the close of the war he, with two brothers, moved to Parkersburg, W. Va., and established a shop for the manufacture and repairing of oil-well tools. Returning to Nashua, in 1867 he, with his brothers, Edward and William J., formed a partnership with the late J. K. Priest, who at that time manufactured sewing machines but later established himself, under the title of the American Shearer Company, as a manufacturer of clippers. It was the idea of the Flather brothers and Mr. Priest to manufacture not only sewing machines but lathes, but the lines were so dissimilar that the partnership was soon dissolved, the Flather brothers taking over the lathe department. It was at this time that the firm of Flather & Co. came into existence, Joseph and William J. being the active partners and Edward the silent one. After several changes in location and varying success, the firm erected a wooden building on the site of their present shop. This building was destroyed by fire in 1876; the shop was then rebuilt of brick on the same location and this building forms a part of the present works. Early in the eighties the firm began to enlarge, and additions were built until the present size was attained. In 1885 Mr. Flather invented the "patent feed" so called, which consisted in placing the rod and screw on the front of the lathe so that either could be driven by both belt and gears. He also invented many other improvements of consequence. In 1901 W. J. Flather withdrew from the firm and the company was incorporated under the title of Flather & Co., Inc., with Joseph Flather as president and treasurer,

JOSEPH FLATHER

which offices he held at the time of his death.

Mr. Flather was widely known in his adopted city and among the manufacturers of machinery. He served his ward in both branches of the city government and was also for a term Representative to the New Hampshire General Court. For ten years he was a member of the local Board of Education, and for the last two years he acted as its president. When the National Machine Tool Builders' Association

was formed in 1901 he was selected as its first president, which office he held for two years. He is survived by his wife and seven children, one of whom, H. L. Flather, is superintendent of the works.

Sammy's Shop—Big Troubles and Problems in the Little Shop

The large shop has its problems which it has to work out in order to be successful, and everybody knows that such is the case; but the small shop has problems, and, although the shop may be almost microscopic in proportion to some of the big ones, the troubles are full-sized ones.

Sammy found it out before he had owned his shop very long. Real business troubles have such an immodest and persistent way of intruding themselves without an introduction, that before he knew what they were he began to be aware of their presence.

DEALING WITH TROUBLE

Some of these troubles do not move in all grades of society, and thus it came about that he had never heard of them; but they soon made him understand that he was now in the society that they had been born and bred in, and that he had to associate with them whether he would or not. It did, at times, seem to him that some of these troubles made a particular mark of his shop and of himself because they were small in this new world, and that they rather resented his entrance into it.

As he grew somewhat and had a broader experience, he concluded that he was wrong in his supposition. He finally came to the conclusion that they were just like other microbes. Some of them grew and thrived under one set of conditions and some under others, and some in one locality only, while others could be found to some extent everywhere. They had to be reckoned with, and active means had to be taken to keep them within bounds, but it seemed impossible to eradicate them. The best that could be done was to keep the system in a healthy condition so that their calls were not encouraged or made congenial. While many of the unwelcomed visitors are without specific names, most of them can be readily recognized and identified when seen.

A DIFFICULT PROBLEM

When Sammy was working alone the work had kept him going quite steadily, and when it did not it had been an easy matter to go to one of his friends and get more; and even after he put on a boy or two and a man it did not seem much different; but, by and by, little gaps began to appear. The work would be too fine for the boys to do, or it would be too coarse and cheap to have it done by a man. Perhaps it would be necessary to work away into the night to finish up work which customers must have, and the next day it would be hard to find anything for the men to do, and the problem of keeping a reasonable balance became an ever present one. To get the work to do, it was necessary to get it out promptly, and while the volume of work might fluctuate very largely the shop force could not fluctuate in the same way.

Sammy had found out very quickly that there are boys, and boys, and machinists, and machinists. Some of them made good hands in a jobbing shop and some did not. Some who were not at first good had the right sort of material in them, and some did not, and it could not be told from the looks of the outside which was which. After trying them and finding a suitable one, it did not seem profitable to let him go and have to repeat the process the next time a little work came in. This off-and-on business gave the shop a bad name among the men as not being a desirable place for a steady man who wanted a steady job. It introduced risks of bad work from some of the unsuitable ones who were being tried out, and it made the educational expenses too heavy.

THE LITTLE SHOP AS A SCHOOL

Don't smile, Professor, at the idea of the little grimy machine shop being a seat of learning. Such places are doing a valuable work. If it were not for them, the big shops would be harder pressed for all-around men than they are now. The educating done in these little shops is of a kind that cannot be done in the big manufacturing establishments, nor in the college of any class. And just here I would like to whisper a secret into the ear of my friend in the large shop who is having trouble to get suitable help. The little shop is in the same boat with him, but with one difference: it does not feel any shortage in the supply of raw material. The valuable man for the job shop is the man educated in the job shop by the job shop for the job shop; and the question is not in the lack of material, but in the ability to select the good material without the expensive work of testing. This is a work that the Society for Testing Materials has not as yet prepared a set of standard rules for doing. After the proper material has been selected and quite an amount of work expended upon it in getting it into shape for use in that shop, the needs of some other shop may induce it to leave and then the process has to be repeated.

KEEPING MEN BUSY

One of the greatest inducements that can be offered for a man to stay in a shop is steady work at fair wages. The wages paid in jobbing shops are generally good, but the problem is to supply the steady employment.

Sammy bought a second-hand pipe machine that he found one of his customers had thrown to one side. It was a hand machine and would cut up to two inches. He rigged up a countershaft and made a power machine out of it, and by getting some bolt dies it was made to serve also for a bolt cutter, and was away ahead of threading with the hand dies. This machine gave a chance to keep the boys busy at odd time. In this country of oil and gas, nipples and bolts were in constant demand, and it was safe to cut up odds and ends of pipe, and put damaged bolts into shape.

ODD JOBS

The true jobbing hand realizes that it is often bare sledding for the boss, and never objects to doing an odd job while his machine is running, and it soon became known that for the democratic sum of a nickel the shop would sharpen a pair of scissors or grind a butcher knife. Any man with a cut going would do these, and they were clear gain. A man with an ax to grind could get the use of the grindstone a reasonable time for five cents.

In the winter the malleable iron skates of the boys who used them on the sidewalks often needed grinding, and 10 cents was the charge. If a man brought in a pair of good skates, it cost him 25 cents to have them properly sharpened. It took less time and more skill to do nice steel ones, but practising on the cheap ones gave an opportunity to acquire the skill.

Sometimes an old engine or pump could be bought at a low cost, and it would be put into good repair at odd times, and helped to fill some of the gaps with the men; but it took some capital to buy such things, and some more to pay for the time and material, and it might be a long time before a customer for them was found. It sometimes happened that they could not be sold for what they had cost.

A FORTUNE LOST

Do you know what it feels like to have a fortune slipping away from you without having the ability to stop it? Five cents may be a fortune if the lack of it makes you walk the length of New York. One day a man came in. He wanted to get some work done. There was nothing about it that the shop could not handle except the quantity. This man was even willing to advance money as fast as the work was done, so that the money question did not enter into it, but the quantity that could be turned out did. He must have a lot of it and have it quickly, and this little shop did not have the capacity even with the utmost stretching. The work went elsewhere, and Sammy lay awake nights thinking about it. He knew how it feels to have a fortune get away.

He found that there were some classes of work which he could not get. Many forgings were wanted, but as he had no blacksmith shop he had to get his forging done by others and often lost ground in that way, and lots of work never came in his direction because he could not make castings.

HANDICAP OF THE SMALL SHOP

Sammy felt his need of a blacksmith

shop, and of a foundry, and of better tools, and when some well meaning friend would buttonhole him and chide him, with the best of intentions, for not being progressive, it hurt; but for all that and in spite of his knowledge of the necessity for these things he could not see how to get them without money, and money was the thing that he did not have.

Circumstances had never conspired to burden him with wealth. He had never yet had a customer demand that a bill be increased before it would be paid, or a man threaten to quit on the spot if his wages were not reduced, or a dealer give him material under the market price because he had to buy in small quantities and take the limit of time to pay for it. Even his wife, willing as she was, had not been able to hint that she could run the home for less than she was doing. If he had lost work because his estimate as to the cost was too low, the fact had never come to his knowledge.

HARD WORK AND LITTLE RETURN

In spite of all his care and work and worry, Sammy found that the debts which he had assumed on buying the shop had not diminished with a rapidity that was at all startling. As an educational device, that little shop may have been a howling success, but as a road to fortune it needed a lot of work done on it before it could be traveled faster than at a snail's pace. As a trail to slowly walk on it may have been well enough, but even the most reckless recognized that it was no road for an automobile. Sammy was not always certain whether, in the direction in which he was traveling on it, it led to or from fortune. So unsettled was he on this point that often he would have gladly disposed of it, if he had been able to find anyone reckless enough to take it off his hands.

While there were many who were ever ready to tell him how nice and independent it was to be able to run a shop of one's own and do as one pleased, Sammy did not take as much stock in such statements as he once did. He knew that he was working harder in every way than he had ever done in his life, and at the same time had been able to spend less for himself and family than at any time since his marriage. If at this time he could have sold out I do not think any real estate dealer would ever have been able to again unload a little old shop on him. Any man who tried to do it would have encountered a severe frost.

ONE KIND OF INDEPENDENCE

If trying to get each customer's ideas so that the work would be done as he ordered it, and inspecting each job after it was done and before the customer came for it, and not using up more time in doing it than could be safely charged on the bill, was being independent, he was independent.

If dogging men around, in season and out of season, so as to get enough money collected to meet the coming pay day was being independent, he was independent.

If keeping silent under criticism of the quality of the work for which there was no apparent excuse, except the desire to have the bill reduced, was being independent, he was independent.

If refusing to help all the various schemes that are dear to the heart of the churches, the societies, and all the other organizations, because he did not have the money to do it with, was being independent, he was independent.

A RUDE AWAKENING

In many other ways he was independent also, but it was with an entirely different kind of an independence than the kind of which he had dreamed in the old days, when he had thought it the boss' privilege to get all the money while the men did all the work.

He was having it borne in on him good and hard that no man in a civilized community is independent in all directions. It might have been cheaper for him to have learned it in some other way, but I do not think that it could have been more thoroughly learned.

And it may be as well not to forget to remember that an all-around mechanic as a business man may be the rankest kind of a specialist. He may think that, in performing the operations on the work in the shop, he is doing all the work, just as the specialist in the shop often thinks that he is doing it all. After he tries being "the whole thing" for a while he either broadens out or gives up the ghost in a business way. Sammy broadened a little.

W. OSBORNE.

A Gas Engine as a Bird Trap

A rather strange solution to a puzzling difficulty was found a few days ago at Sutton-in-Ashfield, Notts, where a small gas engine built by Messrs. Manlove, Alliott & Co., Limited, of Nottingham, and supplied to the Council, had begun to show signs of working in an unsatisfactory manner. One of Messrs. Manlove's fitters was sent from Nottingham, and on disconnecting the air suction pipe, a small wild bird was found lodged in such a position that one of the wings had got under the gas valve, preventing it closing tightly. Apparently the grid at the mouth of the suction pipe had become displaced, and the bird, evidently of an investigating turn of mind, had got too close to the suction pipe and been drawn in by the in-rush of air, carried round the bends and through the length of pipe till it lodged in the restricted area at the valve. Needless to say, the bird was dead when it was discovered to be the cause of the mischief.—*Engineering*.

Cost-estimating Charts

BY J. A. BROWN

The article on "A Cost-estimating Slide Rule" at page 802, Vol. 29, Part 2, leads me to suggest the form of chart shown herewith.

As the labor of computation is but a small part of the total involved, and an analysis of the machine and its capacity forms the more important part of the work, why not make a graphical study of each machine or group of machines, and plot these results in the form of logarithmic diagrams? It is not enough to figure the time or price from assumed feeds and speeds: it is necessary also to know what cut can be taken with a given machine, and its actual speed intervals; and still more to know that when certain feeds and speeds have been selected the shop will use the instructions given. Of course this is largely a matter of organization and shop method.

The equipment described consists of a number of charts made up in folder form, the horizontal scale being about five inches and the vertical scale about ten inches long, or containing two scales similar to the upper or *A* scale of the ordinary slide rule. One moving scale is necessary. This may be made from paper, or (which is a much better arrangement) it may be added to the ten-inch slide rule by pasting over or replacing the scale of inches usually found on the bevel edge.

The advantage of this method is that ordinarily all necessary computations may be made with one hand, leaving the other free to record numerical results.

THE USE OF THE CHART FOR LATHE WORK

The following charts are submitted to show the method employed. They are, however, drawn on standard sheets of logarithmic paper for the purpose of illustration.

Fig. 1 is a chart for a 14-inch engine lathe, belt driven, with four-step cone and a double shift on the countershaft, giving, with the back gears, 16 speeds ranging from 16.5 to 740 revolutions per minute. The relation between the diameter of the work, the revolutions per minute, and the cutting speed is shown by the relation between the horizontal lines, the vertical revolutions per minute lines, and the inclined speed lines, and is given by the formulas on the diagram.

A separate scale, Fig. 2, from which feeds per inch and time are read, is used in connection with the chart.

The operation is very simple. The scale of feeds per inch is placed with the proper feed at the intersection of the horizontal diameter line with either the given revolutions per minute vertical or the inclined speed line, and the time required for one inch of tool travel is read on the movable scale at the extreme right or left of the chart.

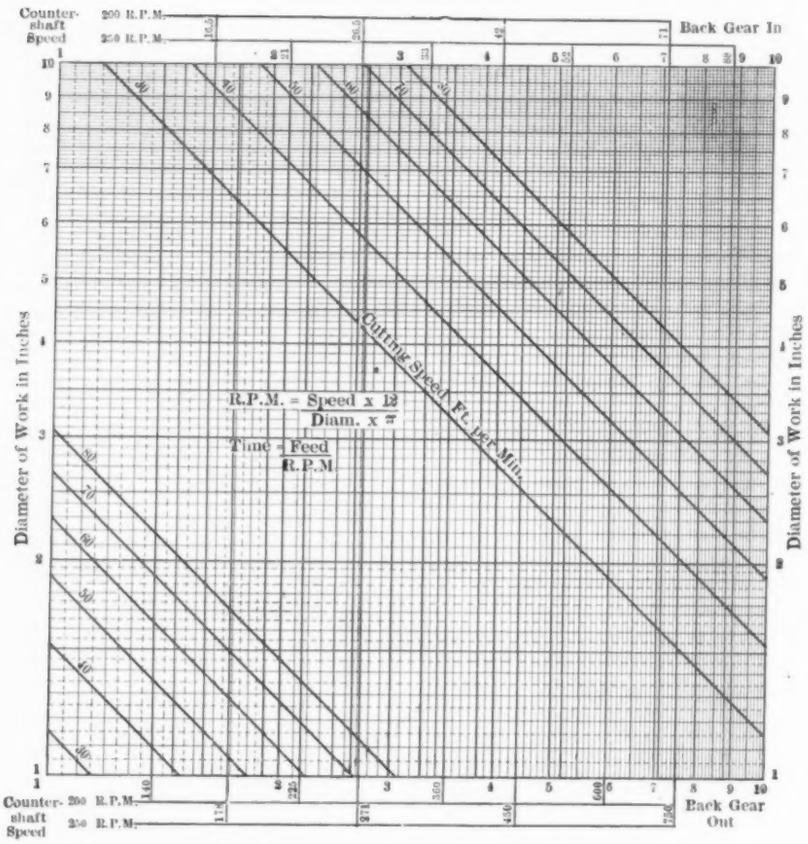

Counter-shaft Speed
200 R.P.M.
250 R.P.M.
Back Gear In
Diameter of Work in Inches
Cutting Speed Ft. per Min.
R.P.M. = Speed x 12 / Diam. x π
Time = Feed / R.P.M.
Back Gear Out

FIG. 1. CHART FOR 14-INCH LATHE

For example, suppose a cutting speed of 50 feet on work of a diameter of five inches. The intersection of these two lines is at 38 revolutions per minute, but we find the nearest speeds available on the lathe to be 33 revolutions per minute, giving a cutting speed of about 43 feet, or 42 revolutions per minute, giving a cutting speed of about 55 feet. If we select a feed of 40 per inch we place 40 on the movable scale at the intersection of the diameter and the revolutions per minute selected. If we choose 33 revolutions per minute, we read the time for one inch of tool travel on the scale movable at the left of the chart, finding 1.2 minutes. If we select 42 revolutions per minute we read the time at the right of the chart, finding about 0.95-minute*.

The formula, time $= \frac{feed}{r.p.m.}$, is given on the chart as it facilitates the location of the decimal point. It is readily seen that $\frac{40}{33}$ is more than one, and that $\frac{40}{42}$ is less than one. This is the simplest case for cylindrical work.

A motor-driven lathe should, in the same way, have the increments of speed given together with such data as the maximum cut permissible at a given diameter, etc.

*The reader may verify these readings by copying the feed per inch scale on a strip of paper and applying it to the chart as described.

THE USE OF THE CHART FOR PLANER WORK

Fig. 3 is a chart for a group of planers in one department. The full inclined lines represent the length of the table or the capacity of the machine; the dotted extensions show the allowance in feet for over-run, reversal, etc., in terms of the effective speed. For example, the 30-inch planer has a cutting speed of 20 feet, and a return of 80 feet, or an effective speed of 16 feet, and requires a time interval for reversal equivalent to two feet of travel. This should be determined experimentally for each machine, the figures given being merely illustrative.

This chart is read in the same way as the preceding. The figure for the feed on the feed scale is placed at the intersection of the horizontal line for length of cut with the inclined line giving the size of the planer, the time being read as before. Example: To plane a surface five feet long by one inch wide using a feed of four per inch on a 30-inch planer. Adding the allowance for over-run $5 + 2 = 7$, set 4 on the feed scale at the intersection of the seven-foot length of cut, and the 30-inch planer lines, and the time is read at the left of the chart as 1.75 minutes. The formula again quickly shows the position of the decimal point; i.e.

$$\frac{7 \times 4}{16} = 1.75.$$

To make the same cut on the 48-inch

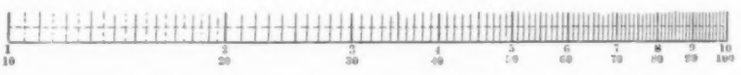


FIG. 2. FEED PER INCH SCALE. READ TIME OF 1-INCH TOOL TRAVEL BY APPLYING TO CHART

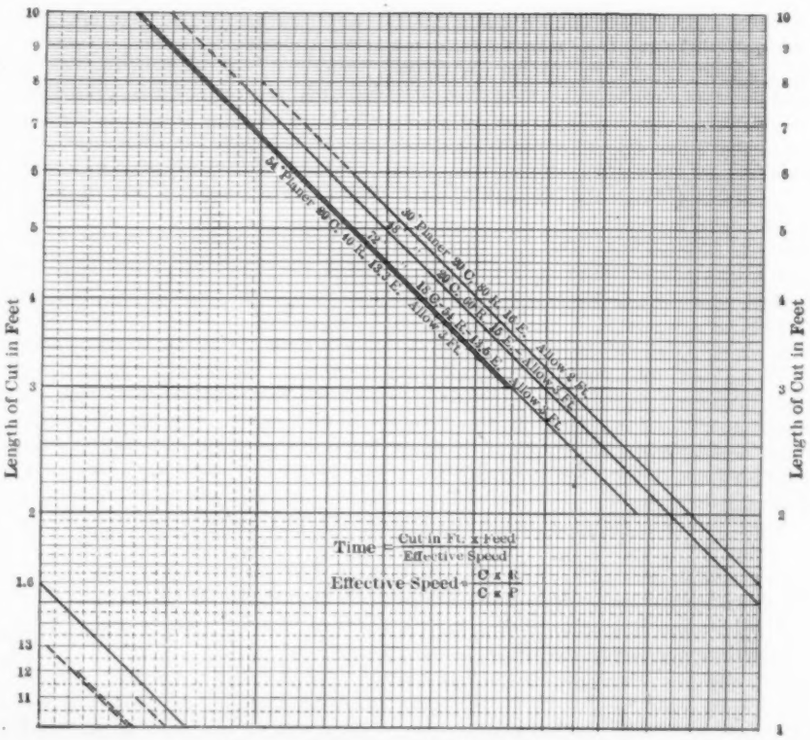

Length of Cut in Feet
54" Planer 60 C. 40 R. 15.5 E. Allow 8 Ft.
30" Planer 80 C. 40 R. 16 E. Allow 8 Ft.
Time = Cut in Ft. x Feed / Effective Speed
Effective Speed = C x R / C + R

FIG. 3. CHART FOR GROUP OF PLANERS

planer, which requires three feet over-run, set 4 on the feed scale at the intersection of the eight-foot length of cut and the inclined 48-inch planer line, and the time will be seen to be about 2.12 minutes.

In the foregoing illustrations it will be noticed that one reading gives the time required for one inch of tool feed for one cut. When two or more cuts are made it is simpler to make a separate reading for each cut, and add the results, especially where the time of setting up the work is allowed, and the total cost figured from the total time so obtained.

It will be seen that data valuable to the shop and to the cost-keeping department may be quickly recorded in this form.

Kinks from W. D. Forbes & Co.

Since my first introduction to the shop of W. D. Forbes & Co., of Hoboken, when they were building the round-column milling machines for Japan, I have always found it interesting, and something new is usually to be seen. They are using a few of this type of milling machine today; and there is a little grinding machine built on the same plan, with a round column, a round bearing for the table, etc., that has not cost a cent for repairs in twelve years.

Near the milling machines is a home-made oil strainer that cost very little and does good work. The body was a heavy sheet-iron ash can, with a cock put in near

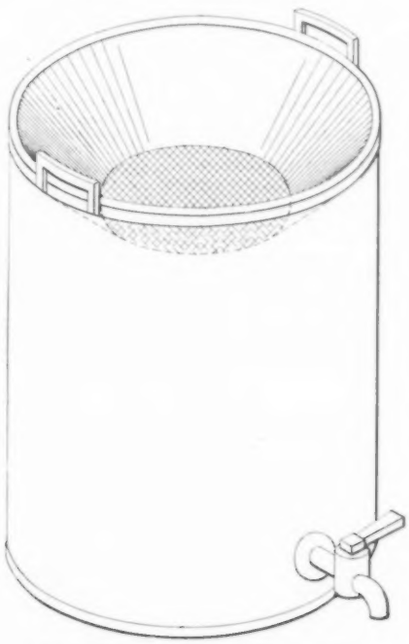


FIG. 1. STRAINING OIL FROM CHIPS

the bottom for drawing off the oil. On the top sits a cone-shaped dish with a fine-mesh wire screen in the bottom, as shown in Fig. 1. Over this is placed a layer of cheesecloth, and the oily chips are dumped in here as they come from the machines. They simply drain by gravity, and seemed to be quite dry when taken out. The first cost is low, and the only running expense is the cheesecloth and the handling of the chips.

High-speed engines are among the regular products of the shop, these going largely into naval and other marine service for lighting. This means careful attention to bearings, as they run in warm

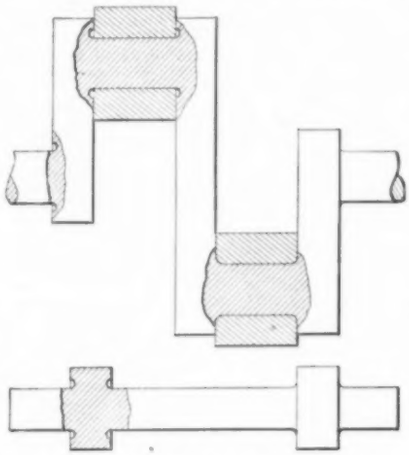


FIG. 2. FORBES METHOD OF FILLETS

places and space is limited. Mr. Forbes has made a departure from the usual method of putting in fillets, which is giving good results. In both the crank-shaft and the shaft with shoulders, in Fig. 2, those at the right are of the usual kind. This reduces the length of the bearing somewhat, as only the straight portion can be used for this purpose. It is further objected that, if the bearing heats, it tends to ride up on the fillets, reduce the bearing on the crank-pin, and so increase the heating.

The plan used here is shown at the left. The fillet is cut in the crank face or in the collars of the shaft. This does away with the sharp corner as effectively as the other method, and has worked out well in their practice.

In place of the usual soft hammer they simply cast small pigs of lead, about one inch thick, 1½ inches wide, and eight inches long, weighing about five pounds. They are used freely by the men, seem to be liked, and have no hard portion to accidentally strike finished work. C.

The Executive Committee of the National Society for the Promotion of Industrial Education held a meeting at the rooms of the Carnegie Foundation in this city, February 9, and took important action relative to the developments of the plans of the society. The secretary announced the election of James O'Connell and John Golden as members of the Board of Managers. Applications for membership have been received in numbers which insure a total annual income from dues of $3075; and the Executive Committee was authorized by the Finance Committee to go ahead with the plans involving a budget of $5000 for the remainder of the present year. Resolutions were passed authorizing the organization of committees to undertake the study of reports upon plans of industrial training suited to the needs of the boot and shoe industry, the textile industry and the building trades, each committee to consist of a student of industrial education to serve as secretary, a representative employer, and a represntative of the employees, and committees on the boot and shoe industry and on the textile industry were organized.

The annual catalog of the Worcester Polytechnic Institute shows a healthy growth of that institution, the total number of students during the present year being 436, against 388 last year, and 325 the year before. The student body is being drawn more and more from outside the immediate locality of the institute, which is thus becoming less of a local and more a national institution. The total number of professors and assistant professors has grown to 18, with 27 instructors and assistants. Additional real estate was purchased last summer by six of the alumni, this purchase giving to the institute the possession of the entire square in which it is located.

Personal

J. B. Gilman, formerly engineer for the American Bridge Company, at Minneapolis, Minn., has resigned to take the position of chief engineer with the Minneapolis Steel and Machinery Company.

F. H. Tenney, for two years with Wellman-Seaver-Morgan Company, as mechanical draftsman and designer, has taken a position with the A. Plamondom Manufacturing Company, as a mechanical draftsman.

J. P. Read, formerly of the New York & Long Island Railroad Company and The Crocker-Wheeler Company has been appointed to a position on the staff of the electrical department of W. S. Barstow & Co., New York and Portland, Ore.

R. R. Pomeroy, formerly with the Brooklyn Edison Company and Interborough Rapid Transit Company, and the New York Central & Hudson River Railroad Company, has been appointed to the position of foreman of electrical construction of W. S. Barstow & Co., New York and Portland, Ore.

Business Items

The offices of the W. P. Davis Machine Company, Rochester, N. Y., have been moved from 130 Mill street to 257 St. Paul street.

The commission appointed by the French government to look into oil engines for the French navy has completed its test and recommended the Mietz & Weiss system, manufactured by August Mietz, New York.

The Royal Motor Car Company, Cleveland, Ohio, have retained Dodge & Day, of Philadelphia, as advisory engineers for the new plant they are preparing to build. The plans are well under way, and work will be started immediately.

Findlay S. Douglas has been appointed manager of motor and generator sales of the New York office of the Sprague Electric Company. Mr. Douglas has been connected with the sales department of the Sprague Company for a number of years.

Dodge & Day, engineers, Philadelphia, are to make a report on the power requirements of the factory of the Denison Manufacturing Company, South Framingham, Mass. This investigation has been made necessary by the rapid growth of their business.

A very large shipment of vises, each weighing 700 pounds, was recently made from one of the factories of the Pittsburgh Automatic Vise and Tool Company, consigned to the Ensley, Ala., works of the Tennessee Coal, Iron and Railroad Company. These are said to be the largest vises ever constructed.

J. E. Snyder & Son, Worcester, Mass., are building a new plant which will double their present facilities. It will be furnished with a Fitchburg steam engine, Yale & Towne crane and other tools and appliances for building upright drills—an exclusive specialty with this company.

The Curtis & Curtis Company, of Bridgeport, Conn., have been compelled to enlarge their plant, increasing their floor space over six thousand square feet. This will enable them to about double the number of mechanics now employed in the manufacture of their pipe cutting and threading machines.

At a meeting of the board of directors of the National Machinery Company, Tiffin, O., held Jan. 30, 1907, a fund was set aside as a pension fund for the benefit of the employees of this company, who, through old age, become incapable of further service. The only requirement is that the employee must have been in the service of the company for a period of not less than fifteen years. All classes of employees, including machinists, foundrymen and yard helpers are eligible, and the rate of pension is $1 per day.

Manufacturers

The Follansbee (W. Va.) Brick and Tile Company has been incorporated and will erect a plant. Virgil L. McGusky, of Cameron, W. Va., is one of the incorporators.

The Montgomery (Ala.) Ice and Cold Storage Company is building an addition to one of its plants in North Montgomery, to be equipped with the latest machinery.

The Grede Bros. Company, Milwaunkee, Wis. will build a $12,000 addition to its carriage factory, which will contain a blacksmith shop and new carriage making machinery.

The Hazard Rope Works, Wilkes-Barre, Penn., has decided to centralize its power plants and will erect a new plant of 1000 horse-power. Electricity will be used.

The Plattner Implement Company, of Denver, Colo., will erect a plant in Lafayette to manufacture wooden water tanks and hay stackers. Electric power will be used.

Miscellaneous Wants

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cox Computers, 75 Broad St., New York.

Caliper cat. free. E.G.Smith Co., Columbia, Pa.

Universal Test Indicator circulars free. H. A. Lowe, Lock Box 146, Cleveland, O.

Light fine machry. to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Dies and Diemaking, $1.00. A shop book by a shop man. J. L. Lucas, Bridgeport, Ct.

Wanted—Cheap belted air compressors. State make, size and price. Box 641, AM. M.

Draftsmen furnished; no charge to employers, no fee for registering. Draftsmen's Exchange, Scranton, Pa.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—A second-hand 1902 pattern, No. 13 plain Garvin milling machine. State condition and price. Box 669, AM. MACH.

Wanted—Upright drills for sale in Great Britain, France and Italy. Will carry large stock. Apply Box 456, AMERICAN MACHINIST.

Wanted—New or modern second-hand engine lathe about 48 ft. swing, 20 ft. bed. The Hastings Pavement Company, Hastings-on-Hudson, N. Y.

Private work solicited by mechanical engineer, designer of air compressors, dry vacuum pumps, steam and oil engines. Box 655, AMERICAN MACHINIST.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACHINIST.

Wanted—To correspond with parties who have light, special machinery to build under contract; our shops are large and fully equipped with modern, up-to-date machinery. Address Trump Bros. Machine Co., Wilmington, Del.

Wanted—The following second-hand machinery which must be in good condition; one compound marine engine, inverted cylinders, 10 and 24 inches diameter, 16 inches stroke approximate; one direct coupled electric generator about 5 kw., one circulating engine cylinder 4 or 5 inches diameter; one surface condenser about 600 square feet cooling surface. Box 623, AMERICAN MACHINIST.

Successful draftsmen drawing $125 to $200 monthly require thorough drafting room knowledge. As chief draftsman of engineering firm I know exactly the quality and quantity of experience and practical training you must have, and prepare you by mail, home instructions for above paying positions, which I furnish free anywhere. Complete highest grade drawing outfit, with German silver set of tools, value $13.85, free. Address Chief Draftsman, Div. 4., Eng.'s Equip't Co., (Inc.), Chicago.

Business Opportunities

Wanted—Concern to do good contract work at low cost on line similar to vertical gasolene engines. Box 659, AMER. MACH.

Mechanical engineer wants partnership with medium sized, but well equipped machine shop first-class patent steam boiler supply; full particulars. Address "Business," 1860 3rd Ave., New York.

We can build machinery for quick delivery. A shop building machine tools wishes to take contracts for the construction of machinery or anything that can be produced in a foundry and machine shop. Send drawings and specifications and estimates will be made with guarantee of quick delivery. We can refer to a standard line of tools now on the market as to the quality of workmanship. Box 75, AMERICAN MACHINIST.

Machine shop and foundry for sale. Here is a great opportunity for two or three good men to get into business; this is a complete plant located in one of the best cities in Ohio; equipment includes 30 lathes, 3 planers, many other tools, completely equipped foundry, boiler shop, blacksmith shop and pattern shop; this plant has fine jobbing trade; price low and terms very reasonable; would like to correspond with practical machinists and foundry men who have some money; can give right men opportunity of their lives. William A. Reade & Company, 402 Chamber of Commerce Building, Cleveland, Ohio.

For Sale

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—One second-hand 800-lb. single frame Morgan steam hammer. Box 660, AM.M.

For Sale—Cyclopedia of modern shop practice, four volumes; bound in green morocco leather. Practically new; cost $18; will sell for $6. Address L. N. O., Box 425, Chicago, Ill.

Wants

Situations and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—Position as chief engineer; have first-class Mass. license; have been instructor in steam engineering; familiar with hydraulic and cross compound condensing and electric plants. Box 648, AMERICAN MACHINIST.

Wanted—A responsible position by a gun expert (37); twenty years' experience as toolmaker foreman, drafting designer and superintendent on fine and medium interchangeable work; A-1 references by past and present employers; any location. Box 615, AM. MACH.

ILLINOIS

Draftsman—Engineer in charge of large drafting room in the West wants work in the East. Box 546, AMERICAN MACHINIST.

Superintendent—Young man, having ten years' experience in charge; a first-class economical, modern organizer and executive; a practical toolmaker, engineer and inventor; excellent references. Box 672, AM. MACH.

INDIANA

Assistant superintendent, master mechanic, or general foreman; am a thorough mechanic, thoroughly familiar with steam engines, gas engines and electrical apparatus; at present employed as mechanical and electrical engineer; open for position about March 15. Box 649, AMERICAN MACHINIST.

MICHIGAN

Wanted—Position as general foreman or tool room foreman, years of experience handling men and designing dies, jigs, and fixtures for small duplicate parts. Box 653, AMERICAN MACHINIST.

NEW JERSEY

Draftsman—Experienced machine designers desire engagement, New York or New Jersey preferred. Box 652, AMERICAN MACHINIST.

Cost accountant desires to locate with manufacturing firm; thoroughly practical and capable of installing up-to-date methods. Box 667, AMERICAN MACHINIST.

Purchasing agent experienced in mechanical, electrical and general supplies wishes position; clean record and best reference furnished. Address "N. K.," AMER. MACHINIST.

NEW YORK

A-1 designer wishes to change position; six years' electrical and mechanical experience. Box 634, AMERICAN MACHINIST.

General foreman of shops; master mechanic, producing varied high-grade work at lowest cost. Box 661, AMERICAN MACHINIST.

Position as foreman and designer by a toolmaker; jigs, gages, diemaking, etc.; $24 per week; 25 years' experience. Box 666, AMERICAN MACHINIST.

Draftsman (mechanical engineer) with excellent college education and experience; age 25, desires position in or near New York. Box 654, AMERICAN MACHINIST.

Designing draftsman; eight years' shop and drafting-room experience; responsible position requiring executive ability desired. Box 639, AMERICAN MACHINIST.

Foreman patternmaker, large experience and technical ability, wants to change location to the middle West. Exceptional references. Box 665, AMERICAN MACHINIST.

Expert in patent drafting and developing desires a few more clients; intricate machinery specialty; A-1 work for A-1 price; secrecy guaranteed. Box 606, AMERICAN MACHINIST

Position as manager of works; held similar position seven years; can improve and design machinery; good mechanical, executive and

business abilities; furnish best of references from concern where now empoyed. Box 374, AMERICAN MACHINIST.

A first-class designing draftsman desires responsible position; at present assistant chief draftsman and checker; experienced on engines, steam turbines, machine tools, jigs and cranes; location, immaterial. Box 673, AMERICAN MACHINIST.

A first-class mechanical draftsman is open for employment; 17 years' experience on air compressor, Corliss and Meyer valve engines, steam and air driven rock drills and electric drills; first-class references. Address Box 633, AMERICAN MACHINIST.

Graduate mechanical engineer, now in charge of engineering department New York office of large manufacturing concern desires to change as manager or representative here or abroad; good executive; first-class references. State full particulars. Box 676, AM. M.

PENNSYLVANIA

Machine shop foreman desires change; good executive; references. Box 621, AMER. MACH.

Technical graduate, 6 years' drafting and shop experience, capable of designing and checking, desires position in South or West. Box 664, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—First-class operator on Jones & Lamson turret lathe; also one first-class all-around machinist. The New Machine Co., Danbury, Conn.

Wanted—Factory cost and estimate clerk; fine town, cheap living; state age, experience, references and pay expected. Good opportunity for right man. Box 643, AMER. MACH.

Wanted—Tool-room foreman, one who has had experience on dies for the manufacture of small parts, such as locks or electrical fittings, and who can handle eight or 10 men successfully; permanent position for the right man; write fully previous experience and salary expected. Box 675, AMER. MACHINIST.

Toolmakers wanted—Several first-class toolmakers on jig, fixture and gage work; only first-class men are required; also, several A-1 diemakers for punching, bending and blanking dies, on sheet and brass work; also several all-around, A-1 machinists, for general repair and new work. Apply to The Yale & Towne Mfg. Co., Stamford, Conn.

Wanted—Foreman for gas engine and tool department; about twenty-five men; must be a good mechanic, able to produce quality and quantity; one of the best and cleanest towns in New England; cheap living; good position to right man; send full details, age, nationality, experience, pay expected, and copies of references to The Progressive Mfg. Co., Torrington, Conn.

ILLINOIS

Wanted—Detail draftsman; preferably one who has had experience on machine tool work; must be sober and industrious and also married man preferred; town of 25,000 people, located about 100 miles from Chicago; state salary expected. Address Box 640, AMERICAN MACHINIST.

Wanted—A designer for work in connection with special automatic rotary swaging machines, of the class of sewing machine needle work; a thorough experience in this line is essential. In replying give age, nationality, training, salary expected and experience. Box 662, AMERICAN MACHINIST.

INDIANA

Wanted—Ten good lathe men; increasing force; good wages; steady employment. Western Motor Co., Logansport, Ind.

Wanted—Lathe men, tool makers, and machinists. Good wages; steady employment; increasing force. The Western Motor Co., Logansport, Ind.

MASSACHUSETTS

Wanted—Two or three experienced toolmakers. Reply Box 645, AMER. MACHINIST.

Wanted—Experienced man wanted to make expansion dies. Reply Box 644, AMER. MACH.

Wanted—First-class high-speed tool hardener, steady work, good pay. Reply Box 646, AMERICAN MACHINIST.

Wanted—First-class machinist; one with experience on hydraulic elevators, engine and pump work. Reply Box 647, AMER. MACH.

Wanted—One man to run a 48-inch lathe, turning cones, in a shop building high-grade machine tools; state experience and give references. Box 87, Springfield, Mass.

Wanted—A good mechanical draftsman who is thoroughly competent in design of cotton machinery, and well up in machine shop practice of same. Reply fully, giving experience and salary required, to "H A. M.," AMERICAN MACHINIST.

MICHIGAN

Wanted—Young man as mechanical engineer for large manufacturing plant; moderate salary to start. State age and salary expected. Box 658, AMERICAN MACHINIST.

Assistant foreman for machine shop in a growing, well-established business, employing 100 men; excellent opportunity for advancement; must be capable of handling men to best advantage with up-to-date methods, also thoroughly understand jig, tool, and lathe work for light, high-grade machinery. State wages, references, ability, etc. Box 656, AMERICAN MACHINIST.

MISSOURI

Wanted—First-class adjusters accustomed to adding machine and typewriter work. Universal Adding Machine Co., St. Louis.

Wanted—Experienced foreman for screw machine department; location, in central States. Box 674, AMERICAN MACHIN ST.

Wanted—One first-class screw machine hand, one used to operating Warner & Swasey screw machine. Kansas City Motor Car Co., Sheffield Station, Kansas City, Mo.

Wanted—First-class machinists, bench men and assemblers; none other need apply but those who have had experience in automobile work. Address Kansas City Motor Car Co., Sheffield Station, Kansas City, Mo.

Wanted—First-class blacksmith to take charge of blacksmith department of five fires; one who has had experience with hammer work, exact forgings and accustomed to very fine work. Box 663, AMER. MACHINIST.

NEW JERSEY

Wanted at Passaic, N. J., a young mechanical draftsman, one with experience on automatic machinery preferred. Box 657, AM. M.

Wanted—Machine designer; technical and practical. Capable of directing five or six draftsmen; permanent position to acceptable party; state age, experience and salary expected. "M. D. X.," AMERICAN MACHINIST.

Wanted—Tool, die and instrument makers accustomed to accurate, complicated work; steady work and good wages to thoroughly competent men; give references. Address Box 438, AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

As we are continually adding to our departments, we have openings for men familiar with engines and pumping machinery; we require lathe, planer, shaper, drill and vise hands, also erectors for inside and outside work; good pay and steady work to good men. Address communications to Henry R. Worthington, Harrison, N. J.

NEW YORK

Wanted—Experienced draftsmen, toolmakers and machinists; give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Wanted—Young man experienced in shop tools and supplies for inside salesman. Address with full particulars. P. O. Drawer, 964, Buffalo, N. Y.

Wanted—Draftsman experienced in designing automatic machinery; permanent position assured if satisfactory. Write Room 64, 45 Broadway, New York.

A number of first-class lathe, planer, slotter and boring-mill hands for both day and night shift; good pay and steady work to good men. The Snow Steam Pump Works, Buffalo, N. Y.

Wanted—First-class diemakers on small and medium blanking, forming, and drawing dies for tin boxes; and general sheet metal work. Steady employment to first-class men. Burdick & Son, Albany, N. Y.

Wanted—An experienced, all-around mechanic, accustomed to small, interchangeable work of the best quality; good manager of men, to take charge of assembling experimental machines; splendid opening for a hustler who can prove that he has the above qualifications. State price; confidential. Address replies to Box 642, AMER. MACHINIST.

Wanted—A man of experience capable of taking charge of raw stores department in firearms manufacturing concern employing 1200 hands, located in Central New York. A person thoroughly familiar with the hardware and mill supply business would be eligible. Good opportunity for the right man. State experience and salary expected. Box 670, AMERICAN MACHINIST.

Wanted—A man for subordinate engineering position who will be given opportunity to demonstrate within a reasonable time his ability to fill position of master mechanic in a metal working plant employing 1200 hands, located in Central New York; must understand upkeep and improvement of buildings, heating, power, lighting, transmission equipment, etc. Give full details, experience and salary expected. Box 636, AMER. MACHINIST.

Wanted—A man to act as assistant to manufacturing superintendent in metal working plant employing 1200 hands, located in Central New York; must have had practical experience in designing and construction of equipment for making small interchangeable parts and getting out production; must have good executive ability and judgment in handling men; one familiar with gun, watch or smal tool manufacturing preferred. State experience and salary expected. Box 651, AM. M.

OHIO

A working foreman wanted for a brass foundry on locomotive work. Address Box 619, AMERICAN MACHINIST.

Wanted—Detailers and designers on heavy machine tool work. Address Niles Tool Works Co., Hamilton, Ohio.

Blacksmiths wanted on locomotive, steady employment and no labor trouble. Address Box 618, AMERICAN MACHINIST.

Wanted—First-class structural engineer capable of designing steel buildings, bridges, etc.; state age, qualifications, initial salary expected, etc. Address 567, AMER. MACH.

Wanted—Toolmaker; man to take charge of tool room and as inspector and gauger on small gas engines; give references, experience and wages expected. Box 668, AM. M.

Machinists—Lathe and floor hands for strictly first-class machine tool work; steady employment; new enlarged works just completed. The Warner & Swasey Co., Cleveland, Ohio.

Screw machine operator; competent to look after 10 Brown & Sharpe No. 0 automatic cutting-off machines on duplicate work; state experience, reference and salary expected. The Cleveland Twist Drill Co., Cleveland, O.

PENNSYLVANIA

Wanted—First-class jig and fixture makers, for fine, light work. Demorest Manufacturing Co., Williamsport, Pa.

Wanted—First-class floor hands and fitters for machine-tool work. Colburn Machine Tool Company, Franklin, Pa.

Wanted—First-class draftsman on machinery for iron pipe fittings; state age and experience. Address, The Kelly & Jones Company, Greenburg, Penn.

Wanted—Good model worker, used to making parts from sheet metal, such as typewriter and adding machine parts. Address Adder Machine Co., Wilkes-Barre, Pa.

Draftsmen wanted—Experienced draftsmen in electrical apparatus, switchboards, transformers, motors and generators; only first-class men need apply; state experience and salary expected. Address Chief Draftsman, Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

RHODE ISLAND

We are continually adding to our force, experienced toolmakers, machinists and draftsmen on special tools, fixtures and models for light, high-grade machinery. Good wages and steady employment. Apply to Taft-Peirce Mfg. Co., Woonsocket, R. I.

VERMONT

Wanted—Foreman for erecting department in shop building machine tools; state experience and give references; good opening for the right man. Box 638, AMER. MACHINIST.

VIRGINIA

Wanted—Elevator erectors experienced in erecting electric passenger elevators. Westbrook Elevator Company, Danville, Virginia.

WISCONSIN

Wanted—A thoroughly competent mechanic to take position of foreman of gang, erecting railway wrecking cranes and other machinery; must be familiar with reading drawings and able to manage men to best advantage. In replying state age, references and wages expected. Address Box 671, AM. M.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reasons for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

Wanted—Foundry foreman; a young married man as general foreman or assistant superintendent in a new modern foundry doing high-grade work; this is a splendid opportunity for a strictly reliable man who is looking for a permanent position in one of the best located cities in the United States. None need apply who have not held good positions and received good salaries; company now employing over 700 men; no labor troubles. Write stating experience fully, salary expected. Address Box 650, AM. MACH.

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Bolts, Coupling
National-Acme Mfg. Co., Cleveland, O.

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Derry-Collard Co., New York.
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Hill Publishing Co., New York.
Sames, C. M., Jersey City, N. J.
Wiley & Sons, Jno., New York.

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Binsse Mach. Co., Newark, N. J.
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Fitchburg Machine Works, Fitchburg, Mass.
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Newton Mach. Tool Works, Philadelphia, Pa.
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Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

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American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
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Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
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Prentiss Tool & Supply Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Fairbanks Co., Springfield, Ohio.

Brackets, Lamp
Standard Welding Co., Cleveland, Ohio.

Brakes, Magnetic Friction
Electric Controller & Supply Co., Cleveland, O.

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Harrington, Son & Co., Edwin, Philadelphia, Pa.
Lapointe Mach. Tool Co., Hudson, Mass.

Bulldozers
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Prentiss Tool & Supply Co., New York.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.

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Athol Mach. Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams
Bilgram, Hugo, Phila., Pa.
Boston Gear Works, Norfolk Downs, Mass.

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Carriers
Lamson Consolidated S. S. Co., Boston, Mass.

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Lumen Bearing Co., Buffalo, N. Y.
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded
Franklin Mfg. Co., H. H., Syracuse, N. Y.

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Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fairbanks Co., Springfield, O.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Hopson & Chapin Mfg. Co., New London, Conn.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Phœnix Mfg. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
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American Tool Wks. Co., Cin., O.
Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland, O.
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LeBlond Mach. Tool Co., R. K., Cincinnati, Ohio.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown Co., R. H., New Haven, Conn.
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Cushman Chuck Co., Hartford, Conn.

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Davis Machine Co., W. P., Rochester, N. Y.
Gisholt Mach. Co., Madison, Wis.
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Chucks, Planer
Niles-Bement-Pond Co., New York.
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Chucks, Split
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

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Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Le Count, Wm. G., So. Norwalk, Conn.
Tudor Mfg. Co., Worcester, Mass.

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Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
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Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons Co., T. B., Chambersburg, Pa.

Clutches, Magnetic
Electric Controller & Supply Co., Cleveland, Ohio.

Coal Handling Machinery
Link-Belt Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleveland, Ohio.

Collectors, Pneumatic
Sturtevant Co., B. F., Boston, Mass.

Compound, Pipe Joint
Dixon Crucible Co., Joseph, Jersey City, N. J.

Compressors, Air
Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas
Ingersoll-Rand Co., New York.

Conduit, Interior
Sprague Electric Co., New York.

Cones, Friction
Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps
Leard, Wm. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.
Chapman & Co., J. B., Springfield, Mass.
Skinner Ship Bldg. & Dry Dock Co., Baltimore, Md.
Turner Mach. Co., Danbury, Conn.

Controllers and Starters, Electric Motor
Case Mfg. Co., Columbus, O.
Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveying Machinery, Auto
Lamson Consol. S. S. Co., Boston, Mass.

Coping Machines
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Cork Inserts
National Brake & Clutch Co., Boston, Mass.

Corundum
See Grinding Wheels.

Cost Systems
American Mechanical Calculator Co., Cincinnati, O.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Mossberg Wrench Co., Central Falls, R. I.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction
Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Cresson Co., Geo. V., Phila., Pa.
Evans Friction Cone Co., Newton Centre, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cresson Co., Geo. V., Phila., Pa.
Electric Controller & Supply Co., Cleveland, Ohio.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Couplings, Shaft—*Continued.*
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

Cranes
Alliance Machine Co., Alliance, O.
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nichols, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.

Crank Shafts
Leard, Wm. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Cups and Covers, Oil
Williams Valve Co., D. T., Cincinnati, O.
Winkley Co., Detroit, Mich.

Cups, Grease
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Nash Company, Geo., New York.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Armstrong Bros. Tool Co., Chicago, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Works, Philadelphia, Pa.

Cutting-off Machines—*Continued.*
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-Off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fairbanks Co., Springfield, Ohio.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos. L., 45 Vesey St., New York.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Boston Tool Co., Cambridge, Mass.
Kent & Co., Edw. R., Chicago, Ill.
Wade Machine Co., Boston, Mass.

Dies, Sub-Press
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Boker & Co., Hermann, New York.
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mach. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Winkley Co., Hartford, Conn.

Drawing Boards and Tables
Alteneder & Son, Theo., Philadelphia, Pa.
Economy Drawing Table Co., Toledo, Ohio.
Keuffel & Esser Co., New York.
Queen & Co., Philadelphia, Pa.
Rich, J. & G., Philadelphia, Pa.
Soltmann, E. G., New York.

Drawing Materials
Alteneder & Son, Theo., Philadelphia, Pa.
American Tracing Cloth Co., New York.
Derry-Collard Co., New York.
Keuffel & Esser Co., New York.
Mittineague Paper Co., Mittineague, Mass.
Queen & Co., Philadelphia, Pa.
Rich, J. & G., Philadelphia, Pa.
Soltmann, E. G., New York.
Technical Supply Co., Scranton, Pa.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drift Bolt Drivers
Ingersoll-Rand Co., New York.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Dwight Slate Mach. Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote, Burt Co., The, Cleveland, Ohio.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

A HIGH EFFICIENCY FLY-WHEEL JOINT

A Construction that Deserves to be Widely Copied

EDITORIAL CORRESPONDENCE

It has come to be accepted as a matter of course that the construction of a segmental fly-wheel which shall have the same strength in the rim as a wheel cast in one piece is an impossibility. Designers have insensibly compared a fly-wheel joint with a boiler-shell joint and considered that a joint having an efficiency of 100 per cent. is impossible in both cases.

As a matter of fact, this view, as regards fly-wheels, is entirely erroneous, expedients being possible with fly-wheels which are impossible with boiler shells; and by the application of these expedients it is entirely feasible to make a fly-wheel of which the joints shall be the strongest part.

EFFICIENCY OF THE BOLTED JOINT

The first to call attention to this fact was John Fritz. Some years ago Mr. Fritz described in a paper read before the American Society of Mechanical Engineers a fly-wheel construction which he had used in many cases at the Bethlehem Steel Works, and in which this result was accomplished. A different application of the same principle has been invented by H. V. Haight, chief engineer of the Canadian Rand Drill Company, Sherbrooke, Quebec, and this construction will be found illustrated herewith. Mr. Fritz's construction was intended for segmental wheels and involved a hollow rim, the making of which for a wheel in halves would involve difficulties in the foundry. Mr. Haight's construction, on the other hand, is equally applicable to segmental wheels or to those cast in halves, and it is precisely this latter pattern of wheel which stands most in need of improvement. The common form of joint used with wheels in halves—a pair of lugs cast within the rim and connected by a bolt, the joints being midway between the arms—is altogether the worst construction of all. W. H. Boehm, manager of the fly-wheel insurance department of the Fidelity and Casualty Company, who has given much attention to this subject, concludes, after analyzing the experiments by Professor Benjamin, that this pattern of joint cannot have an efficiency above 25 per cent., and that in many cases the efficiency goes as low as 20 per cent. Mr. Boehm has tabulated the efficiencies of various forms of joints and concludes that with those in common use the best efficiency that can be obtained is 60 per cent.; although in some recent and very expensive joints, which are reinforced by staggered plates riveted to the sides of the rim, this figure is exceeded.

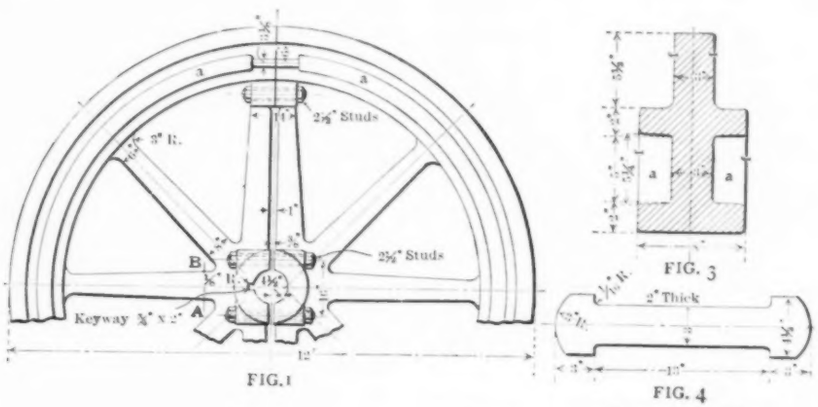

FIG. 1

FIG. 3

FIG. 4

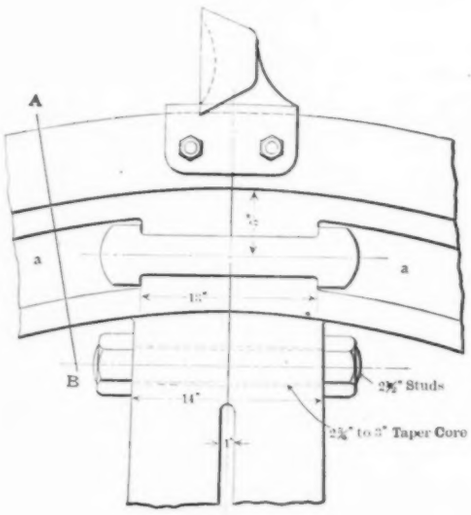

FIG. 2

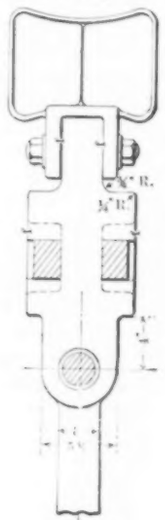
FIG. 5

HAIGHT'S FLY-WHEEL JOINT

WILL THE JOINT BE ADOPTED?

Mr. Haight has supplied a joint of cheap and feasible construction, and with this before them there is no reason why manufacturers should continue to use the dangerous joints which are now so common. Professor Sweet has repeatedly said that it is almost impossible to give away a good idea. Here is a construction by which wheels may be made five times as strong as some, four times as strong as many, and twice as strong as most others. Is it possible that Professor Sweet's dictum shall hold and that Mr. Haight's construction shall pass to the limbo of forgotten things?

THE CAUSE OF THE WEAKNESS OF COMMON JOINTS

The reason why ordinary joints are weaker than the parts which are joined is that those parts are cut away to provide room for the joining pieces. This cutting away reduces the strength of the joined parts, and the greater the provision for strong connecting pieces, the weaker becomes the rim section, the result being that the designer aims to balance the strength of the two parts, and when he has done this he concludes that the joint is the strongest possible. Mr. Haight's plan is to cut away the rim section throughout its circumference, carrying the section which is imposed by the joining pieces all the way around the rim, the result being that the rim is not weakened by making provision for the joining pieces. Since the strength of the rim at the joined end is then the same as that at other points in its circumference, it follows that there is no limit to the extent to which provision can be made for the joining pieces; and it becomes necessary only to make those pieces as strong as the section of the rim in order to provide a joint

which has the same strength as the rim. As a matter of fact, there is no difficulty in making the joining pieces stronger than the rim, or in making the section of the rim at this point stronger than that at other points of its circumference, and we hence have the unique fact that this joint may have an efficiency exceeding 100 per cent.

JOINTED WHEELS STRONGER THAN SOLID ONES

Not only is it possible to design a joint of this type, which shall be stronger than the solid section of the rim, but it is altogether probable that a wheel can be designed on these lines which shall be stronger than a wheel cast in one piece. The usual form of wheel-rim section involves a spongy center, which adds its due quota to the weight of the rim and to the strains to be carried by the rim section, while it adds very little to the strength of the section. Mr. Haight's construction involves a ribbed form of rim, by which this spongy center is largely eliminated, and hence the section of his castings should be stronger than that of the usual form; and, inasmuch as the link can then be made of the same strength as the casting, the conclusion would seem to be inevitable that the wheel as a whole should be stronger than a solid wheel. It is very greatly to be desired that this construction should be tested by Professor Benjamin in comparison with a solid wheel, and I certainly hope he will see fit to make it a subject of experiment.

Mr. Haight's joint was devised for use in connection with the runner of a Pelton water wheel. In such a case, of course, the buckets add to the strain upon the wheel while they add nothing to its strength, and, the speed being high, a high-efficiency joint became necessary. The joint shown is hence a distinct invention which was made in an emergency case—a consideration which will not diminish the reader's admiration for it.

THE DESIGN IN DETAIL

Fig. 1 shows a side elevation of one-half the wheel, and the other views give the joint in detail. The simple removal of the metal which would ordinarily occupy the channels *a a* and its addition to the other parts of the section, where it acts to strengthen the section at the link as well as the remainder of the wheel, accomplishes the seemingly impossible. There could scarcely be a simpler and neater solution of a difficult problem. Fig. 3 is a normal section of the rim, and Fig. 5 a section through the joint, showing the links; the Pelton bucket being shown in Figs. 2 and 5. The extreme diameter of the wheel is 12 feet, and the normal speed is 100 revolutions per minute. With the load removed and the wheel running free, the extreme possible speed of a Pelton wheel is twice the normal, that is, in this case, 200 revolutions giving a rim speed of 7500 feet per minute. It was desired to have the wheel safe under this condition, and, with the load due to the buckets added, calculations show the strain upon the normal rim section to be 1470 pounds per square inch, and upon the links 8800 pounds per square inch. These strains will be seen to be entirely safe, although, had it been thought necessary, the links could have been enlarged and the strain upon them reduced in the manner already described.

The manner of dividing the wheel with the joints at the arms instead of half-way between, as is customary, will be seen to be strictly correct, as the cantilever action of the unsupported ends of the segments is eliminated, this cantilever action being the chief reason for the very low efficiency of the common bolted joint. Experiments by Professor Benjamin have shown that it is this cantilever action which determines the speed at which wheels of the common type let go. The bolts through the arms and within the rim assist the action of the links somewhat, although the reason for their use lies in the machining of the wheel of which the rim had to be turned in order to accommodate the buckets. Were the bolts omitted from the finished wheel no particular harm would be done.

F. A. H.

Strikes and Lockouts in Germany

Consul-General Günther reports from Frankfort that the number of strikes in Germany increased steadily during the three quarters of 1906, amounting to 247 in the first, 655 in the second and 778 in the third quarter.

Of the strikes in the third quarter 140 were entirely successful, 364 partially so, and 278 were unsuccessful. During the three quarters 3515 establishments were affected by strikes, of which 816 were obliged to close down completely. The largest number of striking workmen at any one time was 72,173; that of workmen compelled by the strikers to quit was 3336. The total number of striking workmen was 162,744.

Lockouts were resorted to by 647 establishments, 133 being closed down entirely. The number of workmen employed in these establishments were 29,250. The number of lockouts in the third quarter of 1906 was 76, against 24 in the second and 67 in the first quarter. Of the 76 lockouts during the third quarter 16 were entirely successful, 48 had a partial and 12 no success.

There is quite a boom in industrial enterprises in Japan. Since July, 1905, the new enterprises number 260. These, together with extensions to plants already established, call for a capital amounting to 988 million yen. Of this amount railways are represented by 366 millions, manufacturing by 213 millions and electrical plants by 110 millions.

Sammy's Shop — Its Proprietor Learns a Few Things About Purchasing Supplies

"You seem to have lots of work. All you need is some more machinery. Every time I have been by I have noticed that you are digging in. I have been expecting to hear from you and at least get an inquiry about tools if I didn't get an order."

Sammy looked up from the job which he was trying to get into shape, after one of the boys had been at it, and to get done before the man who ordered it came in. Some men, you know, expect that the boss himself will do every job that *they* bring in, and never make any allowance for work done by a boy; they have yet to learn the boy has to practise on someone's work. He did not know that he had ever seen the man before him.

THE PRACTICAL SALESMAN

"You are the kind of a man that is going to want a lot of machinery as time goes on, and as it is my business to sell machinery it is time that I was getting acquainted with you." Jack held out his hand, and Sammy, after wiping his own on the cleanest available part of his overalls, shook it, and left his mark.

"I am glad to know you," he said, "but I think it is likely to be some time before you sell me much machinery."

"I don't see why that should be. You need the machinery right now. One of our new lathes could handle some of the jobs lying there in half the time either of your present ones will," and he went on to unfold the good points in a most convincing way. He had been a machinist himself for years, and knew what he was talking about. He figured out a nice profit as sure to come from the use of the tools which he could sell, and which would fit into the shop.

SAMMY'S HESITATION AND THE MACHINERY MAN'S OFFER

"I guess that what you say is right enough, but there is no use in wasting your time and breath for I haven't any money to buy with. If it hadn't been for that I would have had more machinery before this."

Jack laughed. "The last thing we ask you to do is to pay for anything. I am willing to let you have it on trial, and you don't need to pay anything until you know that it is all right. It will be earning you something while you are trying it. Then you pay what you can, and if it does take a little time to get it all paid you will not be the only one who does not pay for everything as soon as he gets it."

Sammy hesitated. He was carrying more responsibility now than he felt to be an easy load; but then he did need better and more machinery, and the cuts and description were certainly fine.

"I'll tell you what." Jack kept striking the palm of one hand with the fist of the other as he spoke. "You put this lathe in and try it for a month, and if you don't want it then, send it back. I believe it will be a good thing for both of us if I can get you started to buying once, and you can try that lathe and send it back if I am not right; and it will not cost you a cent except your time in setting it up, if you do not want it."

THE SHOP GROWS AND BUSINESS INCREASES

The lathe came, and that meant another man and more work to keep him going, and it was not long before a drill press had to come to keep the lathe company, and Jack, coming in one day to see how they were filling Sammy's needs, pointed out the advantages that would come from a shaper to do the little jobs that could not be handled on a planer, and soon it was there, too. In spite of himself Sammy found that the shop was growing. With its growth came more customers, and he was constantly reaching out for more work, and getting it.

In his working at the trade, Sammy had picked up a little knowledge of blacksmithing. A small hand forge gave him a chance to utilize it now. He could forge and temper tools, and forge keys, and do other simple jobs, and he found it a convenience. Whenever he had to take a job out to a blacksmith shop he watched the work in a way that he had never done before. He might have call to try to practise the art at almost any time, and especially so on some hurry-up night job.

METHODS OF DIFFERENT SALESMEN

All the salesmen who came around did not do as well by Sammy as Jack did. Some of them charged him entirely too much for what they sold him. Some of them sold him things which their experience should have told them were not of any use to him, and some of them took advantage of his inexperience to deceive him as to grade and quality. As he stayed in business, it is a question whether they showed good business ability any more than they showed good morals. It took him some time to learn that a "standard" grade was often very far from being a good quality. He did believe that it paid to buy good material. He wanted to buy it as close as he could, and was very well pleased at the discount that he got the first time he got some "standard" belt for one of his machines. After having had the belt for a while he made up his mind that in buying belt he wanted something better than that maker's "standard," at any sort of a discount. Unreasonable as it may be (and the belt may have been a fair quality for the price charged), he has always distrusted any statements since made by a salesman from that firm. It was not very encouraging to buy the "best" cast steel, and then get one of the firm's grade lists and find that this steel was nearly at the bottom of the list instead of at the top.

BUYING WASTE AND FILES

All of the mistakes were not due to any intentional deception on the part of the salesman, as Sammy very well understood as his experience broadened. He soon learned that waste at five cents a pound was not the same as waste at eight cents. If he got the same quality delivered that the other man offered at the warehouse, it was about all that he could reasonably expect in the way of a concession.

This matter of grades, discounts, quantities, trade customs, trade names and so forth, he found to be much more complicated than he had supposed, and he began to have respect for the purchasing agent of a large concern who is responsible for keeping his firm right on all such matters. Even in familiar things his knowledge was not accurate. A lot of files came in to fill an order, and the shapes were not at all what he wanted; and it took quite a lot of writing back and forth before he found out that he did not know the proper names for files. He found out that a "flat" file is always a flat file, but that a flat file is not always a "flat" file, that a "half round" file is never half round, that a "three square" file is without any square corners, that a "hand" file is not one cut by hand, and that using a file by hand is not enough to make it a "hand" file; and that, while the files which were used in the mills to file the circular saws were good for some of his work, he must not call for "saw" files, if he wished to get them. About the only files that he had been right on were the "round" and the "square." At first he had ordered directly through a salesman, and the salesman had seen the files which were being used and had put down the correct names in sending in the orders, so that there had not been any trouble.

ONE LESSON LEARNED

Experience showed him that he was largely at the mercy of the salesman, when it came to buying, because of the difference in grades, and that his safest plan was to try to size the man up. If he was honest and had good judgment the goods would be of the quality needed, and at a reasonable price, and if not there would be trouble. One thing he did learn to do and that was to return any goods which were not good enough to use in his business, whether it was his mistake in ordering, or the firm's in sending. In the former case he made the best settlement he could, and in the latter case he declined to pay anything, although he often got stuck for the freight one way.

A BOLT STORY

Even after he had had quite a lot of experience, the very well woven and enticing tale of an artful salesman would beguile him. On one occasion it was a tale of bolts. As the tale ran, the factory was new, and fitted with the very latest machinery, some of it of their own designing. The owners were all experts who had spent their lives in such work, and each one was actively engaged in the company, which was entirely without any dead wood drawing big salaries. The business was being conducted on a large scale so that the very best of prices were obtained in buying the raw material, and to all of these inducements was added the statement that, to get before the consumers quickly, the company had decided to largely forego profits so as to make it an object for people to try their goods.

THE DEAL GOES THROUGH

As the salesman explained, this loss of profits at first was bound to take place anyhow, as it would take much advertising and many salesmen to introduce the goods of a new concern at practically equal prices against those of the established ones. Taken all in all, the story was as reasonable as the mining companies' circulars which help to fill so many waste baskets, and Sammy ordered quite largely for him, for the price was low and there is not much fine work on an ordinary machine bolt. Evidently some parts of the combination in that most modern of bolt factories were not worn down to a good bearing, for those bolts were too poor for even oil-country work; and after looking them over and carefully storing the story away in his memory for purposes of future comparison, he sent them back. There are reasons why he is "not in the market" at times, besides the one that he has a supply of the material on hand.

THE SHOP PROPRIETOR'S CONCLUSION

Sammy is coming to the conclusion that if someone else would sit in the office and sort of look after things in the way of taking in the jobs, looking after the supply and buying of the stock, collecting the bills, keeping the accounts, giving estimates to prospective customers, making financial arrangements with the bank, selecting and hiring good men, forecasting trade and market conditions, passing on the trustworthiness of those wanting credit, and a few other such things, he would be very glad, indeed, "to do all the work."

W. OSBORNE.

Information Wanted

The Cincinnati branch of the National Metal Trades Association wants information relative to the parents of Harry C. Clarke, age 26, machinist, who entered the employment of the Cincinnati Machine Tool Company on October 18, 1906, died on January 25 and was buried in a local cemetery at the expense of the Association. He was of sandy complexion, about 5 feet 8 or 9 inches in hight and weighed about 145 pounds. The Association is informed that his parents live in some place in Michigan, but thus far has been unable to locate any relative.

THE U. S. NAVAL GUN FACTORY AT WASHINGTON, D. C.—VI

The East Gun-carriage and Erecting Shops—Work Less in Weight than that in the Gun Shop, but of Much Diversity

BY H. J. KENNEDY

We will now leave the long shop and walk across Paulding street into the east gun-carriage shop. The gun-carriage shops, which were built in 1855, are brick buildings covering almost as much floor space as the long gun shop, and the work which is done in them is very interesting to a machinist. A good idea of its nature can be obtained from the illustrations in this article. The recoil slides, yokes and mounts require a large variety of operations in their finishing, and this is work which in spite of its often considerable size and the prevalence of angles, curves and general obliquity, requires to be done with great accuracy. Ammunition hoists are also built here and are erected and tested in a model turret.

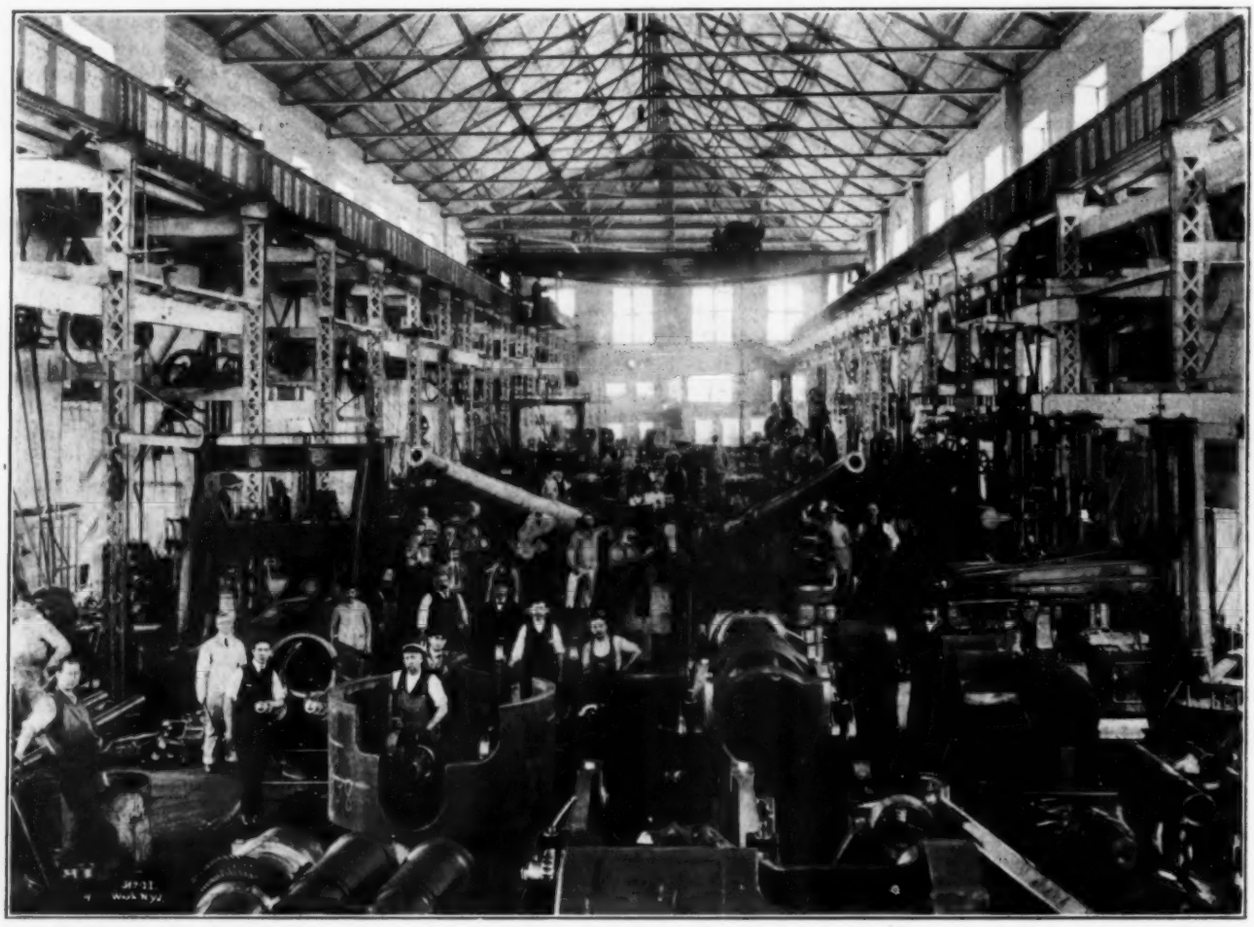

FIG. 38. EAST GUN-CARRIAGE SHOP, LOOKING NORTH

THE EAST GUN-CARRIAGE SHOP

The east gun-carriage shop is the largest of the four in the quadrangle, being 432 feet long, 65 feet 3 inches wide, and 28,188 square feet in area; it is 39 feet 6 inches high at the eaves. Fig. 38 is a view taken from the south end of the shop looking north. The objects which first catch the eye in looking at this picture are the two mounted guns sticking up on each side of the center of the picture, which are six-inch, 50-caliber guns. On the right are some Bement, Miles & Co. radial drills, shown on a larger scale in Fig. 42. Next beyond them are Betts boring mills, and then a Bement, Miles & Co. horizontal boring, drilling and milling machine, with a 98-inch table. Next are three Bement, Miles & Co. horizontal boring machines, with tables 70 inches square, then two Bement horizontal boring machines, having tables seven feet by 102 inches, and five-inch bars traveling six feet. Then come two Niles slotters, with 51-inch tables and 30-inch stroke. In the foreground is a shield for a 6-inch gun. On the left, a recoil slide for a 6-inch gun, and on the right a recoil slide for an 8-inch gun. Under the radial drill is a top carriage (the part of the mount which contains the trunnion seats in which the trunnions of the slide rest). The planer on the left, with the ghostly blur of a moving piece of work on its table, is a Bement, Miles & Co. machine with a table 120x42 inches, and taking 52 inches between the housings.

Fig. 39 is a view taken from the north end of the east gun-carriage shop looking south. On the left is a Niles slotter, having a stroke of 30 inches, and a 51-inch table, working on a top carriage. The

FIG. 39. EAST GUN-CARRIAGE SHOP, LOOKING SOUTH

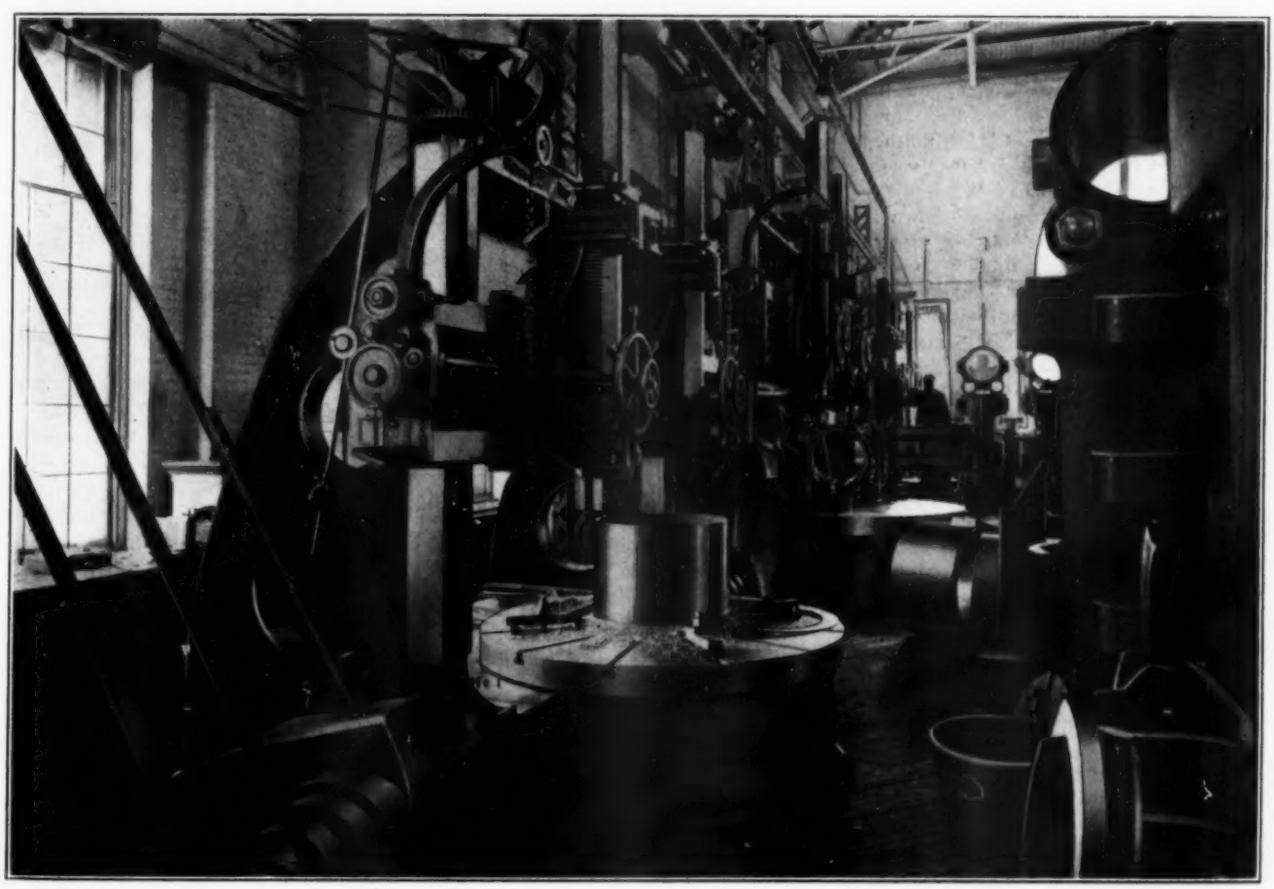

FIG. 40. BORING MILLS IN EAST GUN-CARRIAGE SHOP

next machine is a Bement-Miles horizontal boring, drilling and milling machine, with a table 70 inches square, and a head travel of 66 inches. Then come three machines of similar design, but larger in size. On the right is a Bement-Miles horizontal boring, drilling and milling machine, with a table 35x58 inches, and a bar travel of 58 inches. Beyond that on the right is a Bement, Miles & Co. planer, with a table 120x42 inches, taking 52 inches between housings; it is very apparent that the planer was in operation while the picture was being taken. The two mounted guns of the previous picture may be seen away off at the far end of the shop. On the right is a row of top carriages for 6-inch guns, lying on their sides, and in the center of the floor are mounts for 5-inch guns, marks VIII and IX, and to their presence is principally due the multiplicity of hand-wheels in the middle of the picture, these being the wheels used for training and elevating the guns.

Fig. 40 is a nearer view of some Niles boring and turning mills in the east gun-carriage shop. The first machine has a 64-inch table, swings eight feet, and has an elevation of 48 inches, a bar travel of 30 inches and a six-inch bar. It is engaged on boring and turning a brass bushing liner for a six-inch gun slide. The machine beyond this has an eight-foot table, swings 12 feet, elevation 72 inches, and has a seven-inch bar traveling 48 inches. It is turning the trunnions on a recoil slide for a 6-inch gun. The bore of the steel casting is 24 inches, its outside diameters 33 inches and 28 inches, and the length of the casting is five feet nine inches. A similar piece is being finished on the third machine, which has a seven-foot table, and swing of 10 feet.

A yoke for a 12-inch gun is shown in process of construction in Fig. 41, in which a 36-inch Bement, Miles & Co. slotter is performing a minor operation, viz., slotting between the lugs of the yoke. This piece of work has an inside diameter of 48 inches, outside diameter of 4 feet 5 inches, and is 5½ feet long over the lugs. Back of the yoke, and, at first glance, apparently piled on top of it, is a lot of recoil slides for 8-inch guns.

In Fig. 42 we see four 8-foot Bement-Miles radial drills, working on gun carriages, recoil slides, etc. At the right is a slide carried on the mount by its trunnions. In Fig. 43 is a Niles slotter with a 30-inch stroke and a 51-inch table at work on a yoke for a 7-inch gun, having a diameter inside of 29 inches, outside 33½ inches, and a hight of 19½ inches. Lying on blocks is a forging for a 5-inch 40-caliber navy gun; to the right of the gun are some pedestal mounts for 6-inch mark X guns, in which can be seen the trunnion seats in the top carriages, and the gearing for pointing the guns; to the left is a lot of slides for 5-inch mark IX guns, in which the recoil cylinders have evidently been completed, as shown by the numerous piston rods sticking up with nuts on them.

One tool which attracts attention in the east gun-carriage shop is a large John Roach slotter built by the Morgan Iron Works in 1869. This machine has a table of 8 feet in diameter and a stroke of 36 inches. Originally the table had a hand feed; but an automatic feed was subsequently rigged up.

THE ERECTING SHOP

In walking around the series of buildings which form the big quadrangle, we pass through the erecting shop, which is the smallest of the four: 134 feet 6 inches long by 80 feet wide, 10,760 square feet area, and 39 feet 3 inches high. A view of it is given in Fig. 44, the work going on being the erecting of 12-inch guns, turret-operating mechanism, ammunition hoists, etc. At the extreme left can be seen part of a Detrick & Harvey planer; the big object this side of the planer is a recoil slide for a 12-inch gun. In the middle of the picture with its slide on it is a superposed mount 8-inch 45-caliber gun, breech 37 inches diameter, and muzzle 12 inches. To the right of the gun is an 8-inch slide. The structure in the background to the right is where electric ammunition hoists are set up and tested, just as if the overhead platform were the deck of a ship. The rails up which the little car runs are curved, some wooden templets for the curves being shown hanging in front of the frame work.

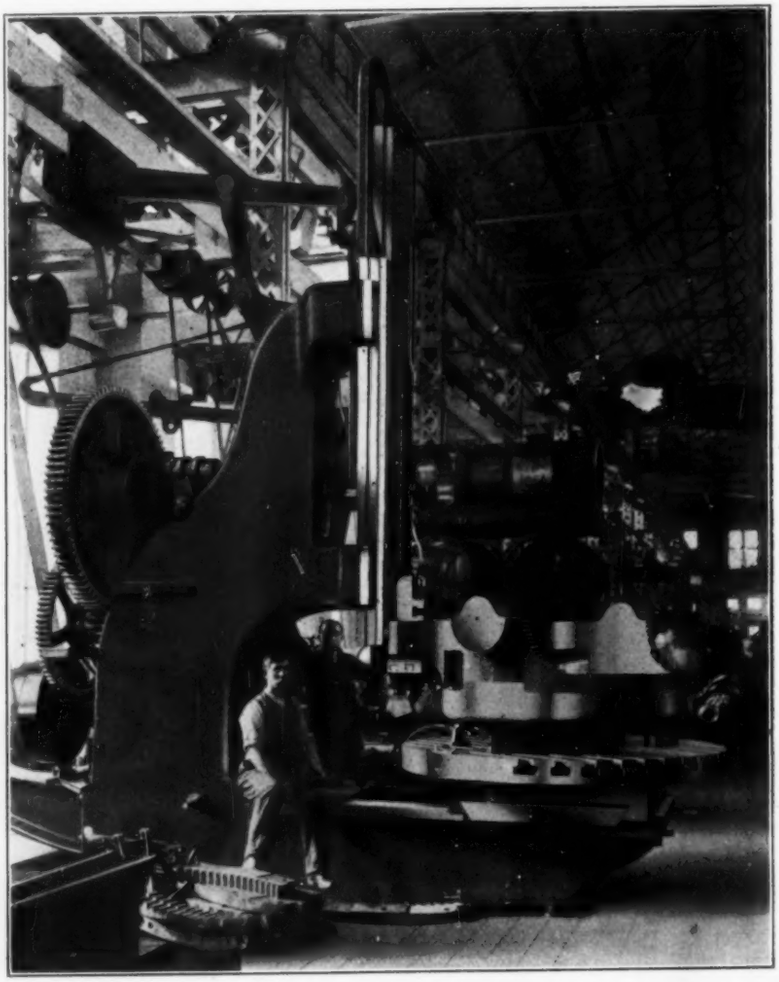

FIG. 41. FINISHING A 12-INCH YOKE

Use of the Lead Pot in Hardening — Cyanide Solution

BY E. R. MARKHAM

At one time I was an enthusiastic advocate of the use of the lead pot as a means of heating steel for hardening. Under certain conditions I advocate its use now, but experience has taught me that many times it is a source of serious trouble.

Many times it is desirable to harden large numbers of comparatively small pieces which are nearly uniform in size. Now, if the outer surface is to be ground away after hardening, and the size and shape of the piece are such that uniform heats result from the use of lead, well and good; under such conditions excellent results follow, as the very thin decarbonized surface being removed by the grinding operation leaves a hard surface for wear

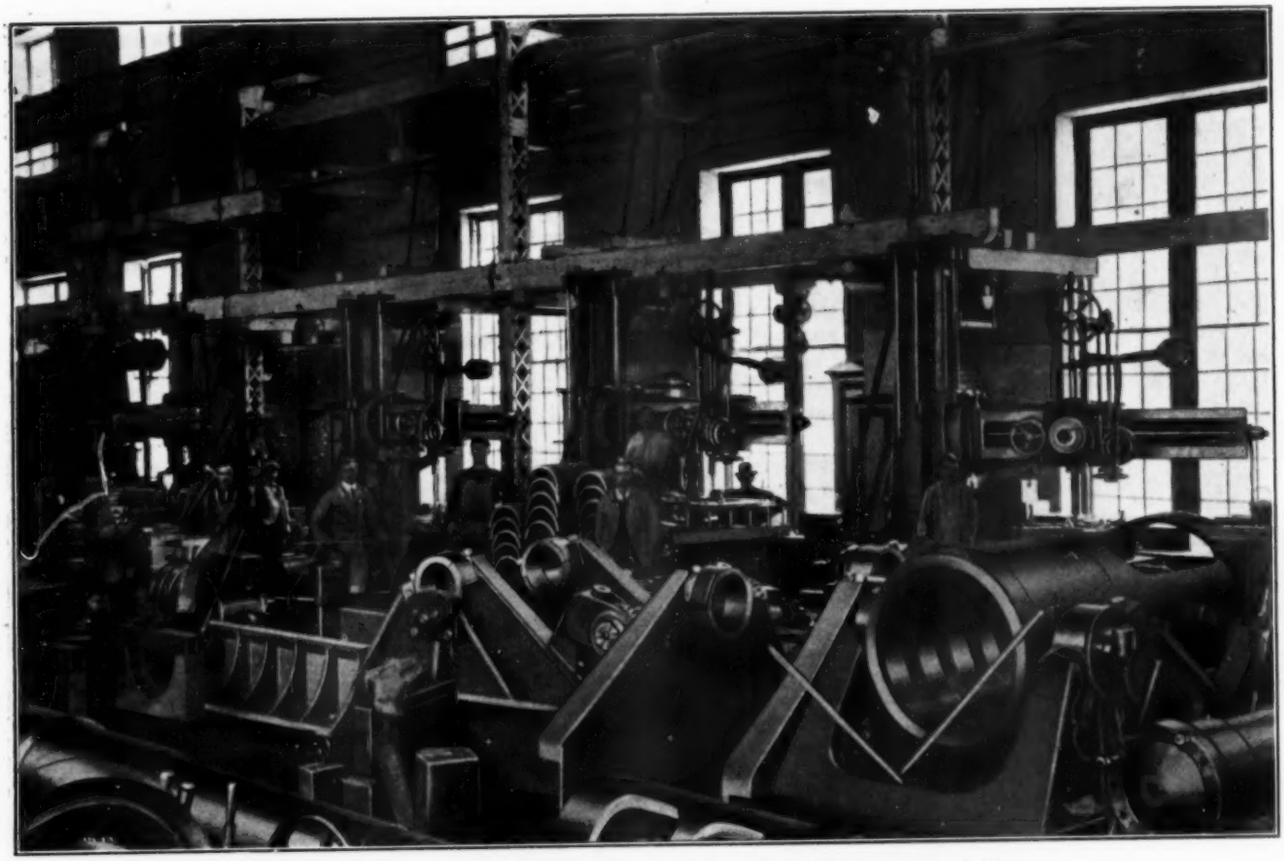

FIG. 42. RADIAL DRILLS AND GUN MOUNTS IN EAST GUN-CARRIAGE SHOP

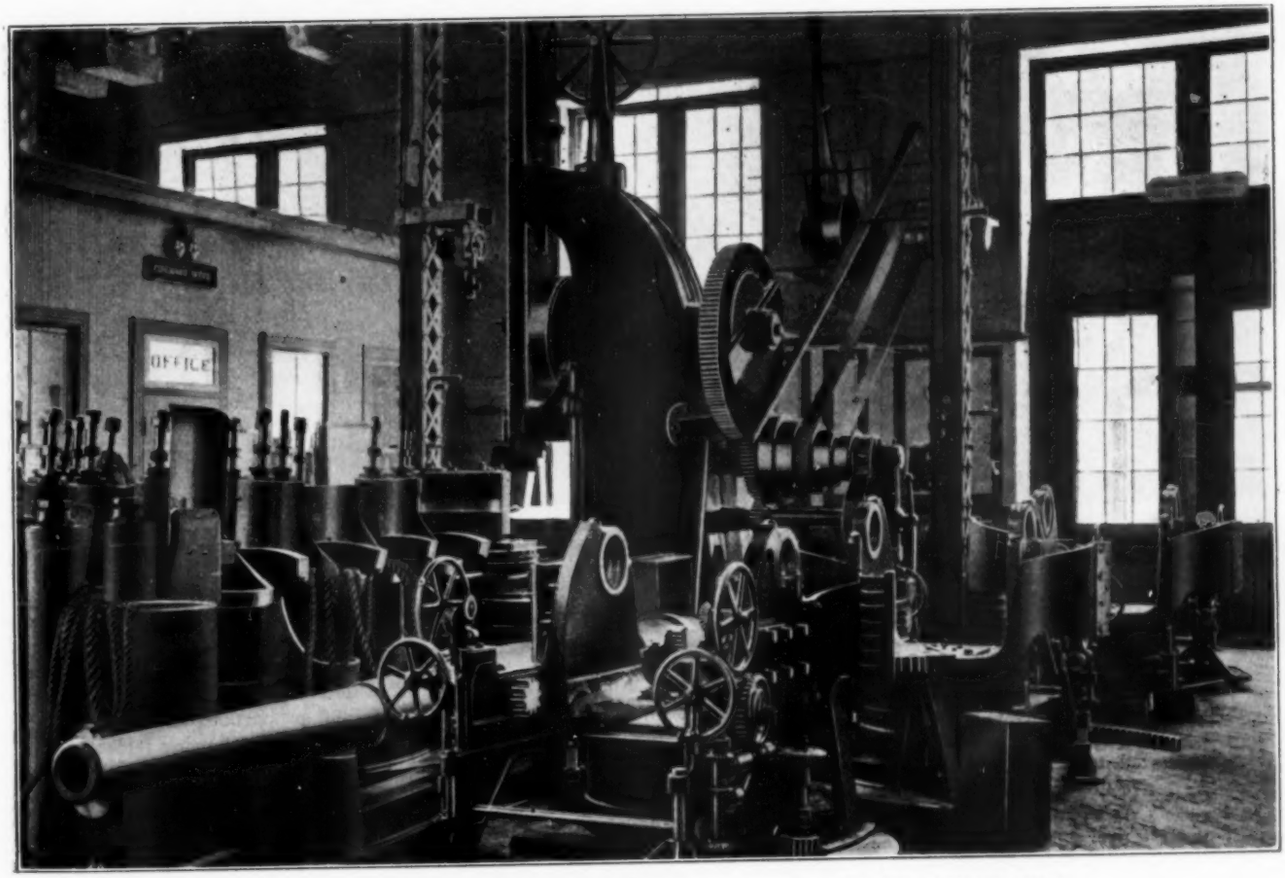

FIG. 43. GUN SLIDES, A SLOTTER, AND PEDESTAL MOUNTS IN EAST GUN-CARRIAGE SHOP

CYANIDE PREVENTS LEAD STICKING TO WORK

In order to prevent lead adhering to the surface of the pieces heated in it, it is customary many times to dip them in a saturated solution of cyanide of potassium before placing in the lead pot. It is necessary to dry the steel before putting it in the lead or the violent ebullition would cause the lead to fly, thus endangering the eyes of the operator. The drying process is generally accomplished by placing the pieces on the plate on top of the fire; not only are the pieces dried on the plates, thus leaving a coating of cyanide on the surface, but also they are pre-heated before placing in the lead. The cyanide melts when the steel is heated in the lead and forms a cushion around the steel, preventing oxidation, and the lead sticking to it.

JUDGMENT AND CARE NECESSARY

For articles having very light projections from the surface the cyanide might prove objectionable, especially if they were to be subjected to strain, but generally speaking I have not seen bad results follow its use. As no general rule can be laid down, the operator must be governed by his experience or by the results of experiment.

In preparing the solution it is advisable to first pulverize the cyanide, then turn it into boiling water, adding all the cyanide the water will dissolve. When cold it is ready for use. The operator must bear in mind that cyanide of potassium is a *violent* poison and exercise care when using it.

PRE-HEATING

Pre-heating is advisable and in many cases absolutely necessary in order to prevent the steel cracking from unequal expansion when placed in lead heated to the necessary temperature. This is especially true of large pieces, or those of unequal size. A moment's reflection will convince one that a piece of cold steel is brittle and unyielding, and if suddenly exposed to an extremely high temperature the outer portion and lighter sections will be heated, and consequently expanded, before the balance of the piece, thus tearing it apart, or seriously weakening it by setting up strains which are bound to manifest themselves at some time.

THEORY AND PRACTICE

I am free to confess that in visiting shops and attempting to help parties out of difficulties, I am forced many times to change my views. I find that theories I have held do not prove to fit certain cases. This is especially true regarding the heat treatment of steel. I recall a large tap which gave serious trouble when hardened; this tap was heated in a gas furnace of the oven type. The surface of the teeth would not harden; the body of the tap beneath the surface seemed to harden all right. As I had had many similar cases and knew that the trouble came from a decarburization of the surface, I had a large coke fire built in a blacksmith's forge; and the tool was carefully heated and hardened perfectly.

A PASTE USED ON TAPS

As they had many similar pieces to harden, and the forge was in an out-of-the-way place, and they were desirous of using the gas furnace, we covered the surface of the steel with a mixture of salt and carbonaceous material to protect the teeth from decarbonization and oxidation. The kinds and proportions of the ingredients are given in the following table:

Pulverized charred leather	1 pound
Fine family flour	2½ pounds
Fine table salt	2 pounds

The charcoal made from the charred leather should be triturated until fine enough to pass through a No. 45 sieve. The three

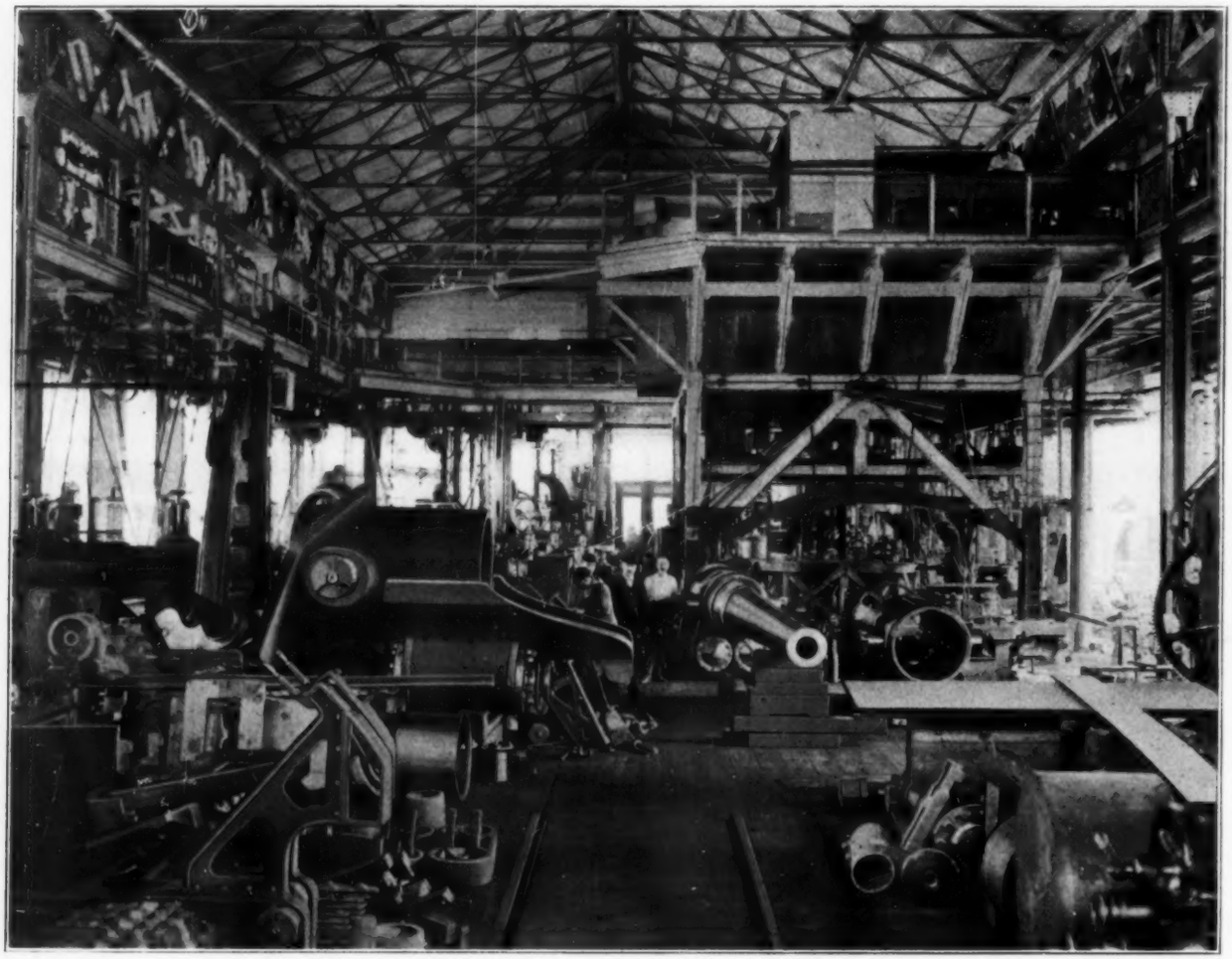

FIG. 44. ERECTING SHOP

ingredients are thoroughly mixed and incorporated while in a dry state and water is then added slowly to prevent lumps until the paste formed has the consistency of ordinary varnish.

A SATISFACTORY TREATMENT

The taps were covered with the paste above mentioned. After drying they were placed in the gas furnace and heated to the desired temperature, when they were quenched in a bath of brine, with excellent results. As an experiment the shanks of several of the taps were *not* covered with the paste, but were left exposed to the decarbonizing influence of the air in the flame, and while the portion covered was hard, the exposed part showed a soft surface. I have since been informed by letter that they use the mixture on all tools whose size makes it necessary to subject them to the action of the furnace heat for any considerable length of time. Small pieces do not require this treatment, as they heat rapidly and do not become decarbonized.

HEATING LARGE WORK

Only last week the superintendent of a large blacksmith shop informed me that they were having trouble "galore" when heating large pieces for hardening; the articles showed a soft surface, and as they could not be ground to remove this surface, they were obliged to stop using their gas furnaces for this work and resort to coke fires. We found, however, that when the pieces were placed in a tube, or a box made from sheet iron, and so kept from coming in contact with the direct heat, everything worked all right.

In conclusion let me say that soft surfaces, where the bulk of the steel is hard, lead the experienced man to the decision that in some way the surface is decarbonized. Generally speaking, this is the result of air coming in contact with the steel, either from the blast or from exposure to the atmosphere, and, knowing the cause, it is generally a comparatively simple matter to find a remedy.

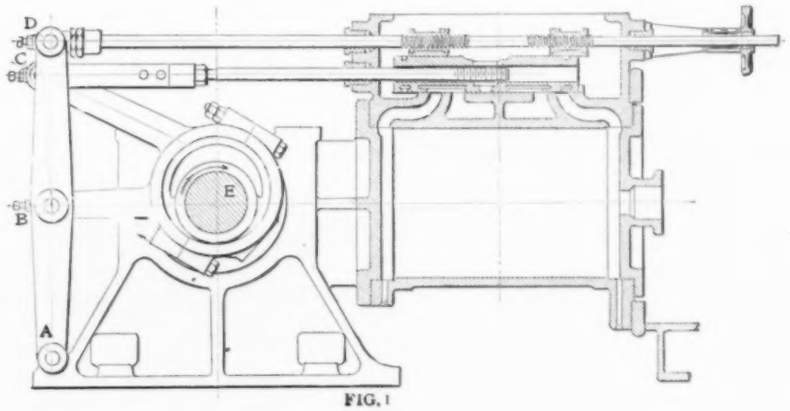

FIG. 1

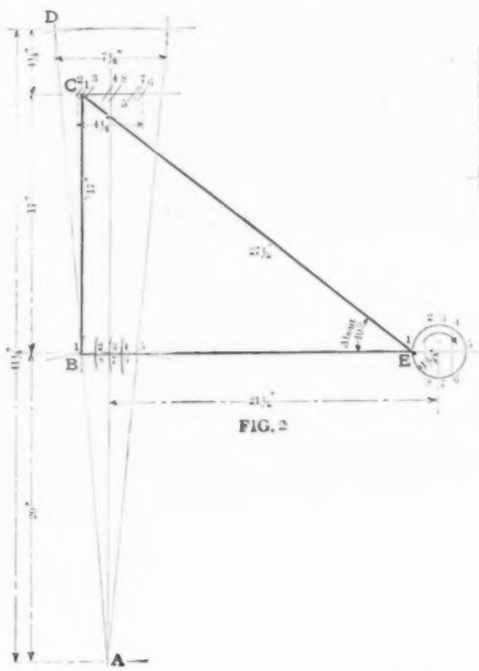

FIG. 2

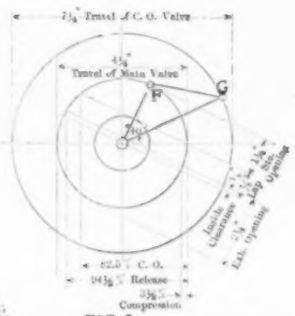

FIG. 3

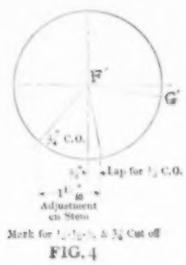

FIG. 4

SINGLE-ECCENTRIC MEYER VALVE GEAR

Single-eccentric Meyer Valve Gear

BY H. V. HAIGHT

The accompanying drawings illustrate a Meyer valve gear in which both main and cut-off valves are driven from a single eccentric. This gear is used on the steam cylinders of straight-line air compressors.

Referring to Fig. 1, it will be seen that the main valve is driven by pin *C* on the eccentric strap, while the cut-off valves are driven by pin *D* on a rocker, which in turn is driven by pin *B* on the eccentric strap. The rocker is pivoted to the pillow block at *A*. This style of valve gear not only does away with one eccentric, one eccentric strap and one rocker, but it enables all the pins to be supported at both ends and placed so that the bearings are in direct line with the stresses, and there is no twisting action on the rocker. The cost sheets show this style of valve gear to be cheaper than the ordinary style using two eccentrics and two rockers.

It will be noted that the machine runs "under." In order to make it run "over" it would be necessary to drive the main valve from the rocker and the cut-off valves from the eccentric strap, which makes an awkward construction and does not give as good a valve diagram.

LAYING OUT THE GEAR

The method of laying out a valve gear of this kind would be about as follows:

In laying out the cylinder, the length of the ports will be made about three-quarters the diameter of the cylinder, and the width will be made such as to give a velocity of 4000 to 5000 feet per minute. The steam opening will be made about three-quarters of the width of the port. The trial valve diagram for the main valve may then be laid out. For air compressors the valve has no lead and the compression is made small. The point of release will depend somewhat on the piston speed. The inner part of the valve diagram in Fig. 3 shows suitable percentages of cut-off, release and compression for a valve gear for this purpose. Having obtained the travel of the main valve, the next step would be to make the valve-gear layout, Fig. 2. An even figure would probably be chosen for the throw of the eccentric, which might bring the travel of the main valve slightly greater or less than that in the trial valve diagram. The final diagram may now be laid out. The angle between *B E* and *C E*, Fig. 2, gives the angular advance of the virtual cut-off eccentric, while the diameter of the outside circle in Fig. 3 will, of course, be made equal to the travel of the cut-off valves as shown by Fig. 2.

Fig. 4 is then laid out by making *F'*, *G'* equal and parallel to *F*, *G*. The other positions for *F'*, *G'* are drawn for the minimum and maximum cut-off desired.

After working out this valve gear, some five or six years ago, I found that a very similar design was in use on the Norwalk compressor, so that I do not think that it is very new. It is, however, a good valve gear and deserves to be better known.

A NEW 16-INCH TOOLMAKERS' LATHE

Especially Adapted for Tool and Other Precision Work—Equipped with Various Novel Devices

The accompanying half-tones and line engravings illustrate a recently designed 16-inch lathe in which are incorporated a variety of features of novelty and interest. This tool is built by the Pratt & Whitney Company, Hartford, Conn., and is known as their 16-inch toolmakers' lathe, its construction adapting it especially to the handling of tool and other precision work and its equipment including, among other convenient appliances, a taper-turning attachment, a relieving device for backing off cutters, hobs, etc., and complete sets of spring collets, expanding bushings, and step chucks and closers.

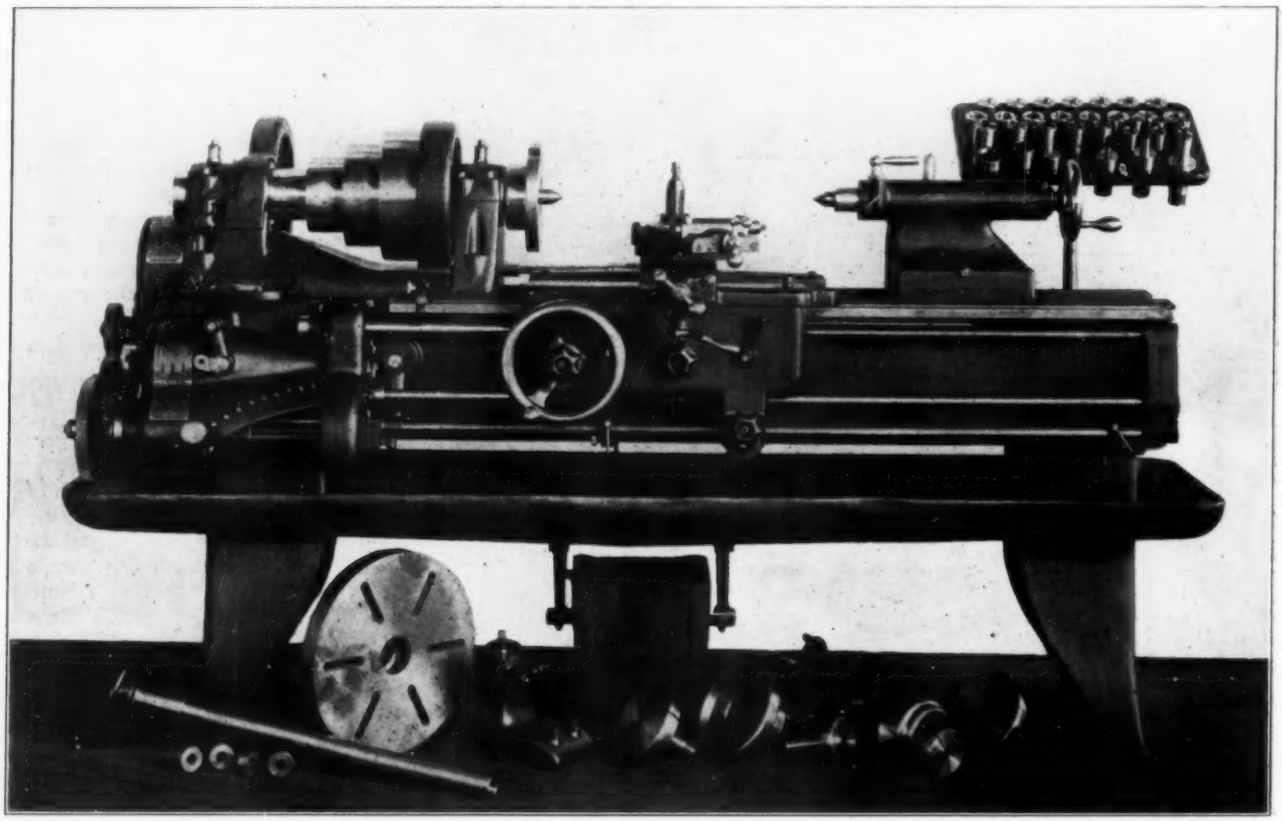

FIG. 1. 16-INCH TOOLMAKERS' LATHE

The lathe is built with two types of headstocks; one with stepped driving cone for the spindle, and the other with all-gear mechanism which is driven either by a single belt running at constant speed, or, where desired, by a motor mounted directly on the casing inclosing the head mechanism. In all other respects the two lathes are precisely alike.

An admirable conception of the design and of the general appearance of the lathe as equipped with the usual driving cone for the head may be obtained from Figs. 1, 2, and 3. These engravings show, among other features, the gear box by which the carriage and cross feeds are controlled; the conveniently located outfit of draw-in collets and expanding bushings; and in the case of the rear view, Fig. 2, the taper turner and the backing-off attachment, which, as will be perceived, derives its motion from gearing located at the end of the headstock.

THE HEAD AND SPINDLE.

Three similar views of the head from the front are presented in Figs 4, 5 and 6, the first of these showing the method of holding spring collets; the second, the expansion bushing system providing for the mounting of work by the bore while further operations are performed upon it; the third, a portion of the step chuck and closer outfit, the chucks, which are shown blank, being bored out by the operator to suit the work in hand.

A sectional view of the head is presented in Fig. 7, the drawing-in tube and handwheel for operating the spring chucks, etc., being removed. The spindle runs in babbitt boxes, which are compressed, bored and scraped after pouring, and has a front bearing 2⅞ inches diameter and 4¼ inches long, while the rear bearing is 2⅜x3 7/16 inches. The end of the spindle is provided with a hardened and ground nose of conical form upon which face plates, chucks, and step-chuck closers may be drawn snug and true. The hole at the front end of the spindle is No. 10 "Jarno" taper and the largest stock which may be passed through the tube and spring collets, 1¼ inch. The 4-step driving cone takes a 3-inch belt and its grades range from 4¼ to 10¾ inches in diameter. The back gear ratio is 9.1 to 1 and with a 2-speed countershaft running at 114 and 150 revolutions per minute the spindle speeds with open belt range from 64 to 441 and with back gears from 7 to 49 turns per minute, the total number of speeds being 16.

THE FEED-GEAR DRIVE.

No backing belt for the counter is provided for, as feed-reversing gears, which are controlled by a knob conveniently placed at the front of the apron and also thrown out of action automatically by

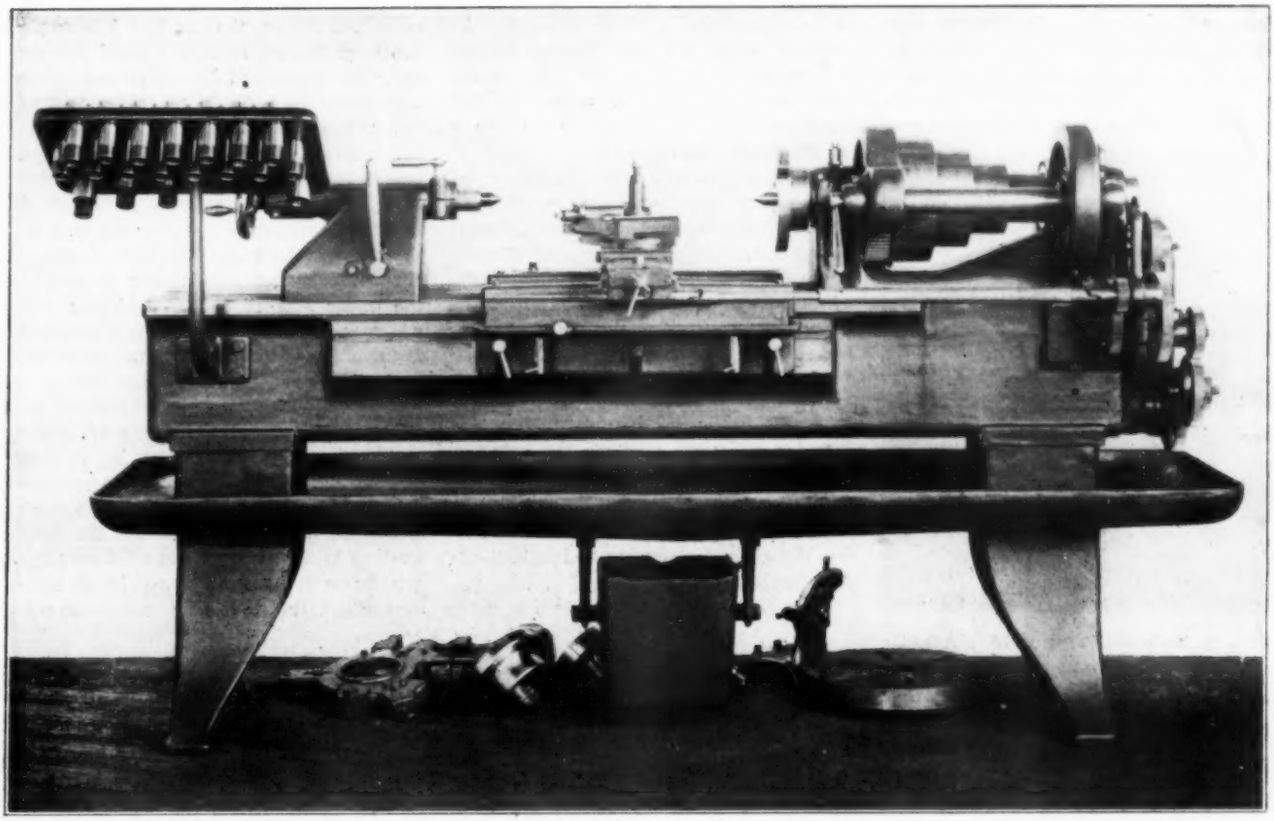

FIG. 2. REAR VIEW OF 16-INCH TOOLMAKERS' LATHE

stops operated by the carriage, are arranged under the head. These gears are shown at *A A* with a clutch between and the pinion through which they are actuated from the spindle is represented at *B*. This pinion is mounted upon a stud whose outer end, milled to form a rack, engages with a pinion which, by means of a knob shown at the front of the head in Fig. 1, may be turned to slide gear *B* out of engagement with the driving gear on the spindle, and thus disconnect the entire feed-gear train. The teeth on the combination spur and bevel gear *A* with which pinion *B* engages are of sufficient length still to engage the latter when it is slid inward clear of the driving gear. Thus the sliding gear is easily shifted again into mesh with the driver, when it is desired to connect the spindle and feed-gear train.

The reversing bevels *A A* are carried by shaft *C* which is driven in either direction according to which of the bevels is engaged by the clutch, and to the outer end of the shaft are keyed two gears *D* and *E* meshing respectively with *F* and *G*. These gears are shown also in Fig. 8, which gives an end view and a front elevation of the headstock and the feed-gear box, and an explanation of the construction of the latter may therefore be given at this point, preliminary to describing in detail the carriage which it operates.

THE GEAR BOX.

The gears *F* and *G* just referred to are mounted loosely, side by side, upon stud *H* and by manipulating sliding-key *I* by means of handle *J* either gear may be connected to *H*; thus the stud has two rates of speed for each speed of the spindle. On the outer end of *H* and on shaft *K*, which passes through the gear box, are placed change gears connected by an intermediate carried on the swinging quadrant, and motion is thus transmitted to the gear-box mechanism. The change gears, by the way, are four in number, two 80-teeth, one 40 and one 92 (the latter for 11½ threads per inch), these with the gear cone in the box giving the required range of screw-cutting and turning feeds.

On shaft *K* is mounted a long pinion,

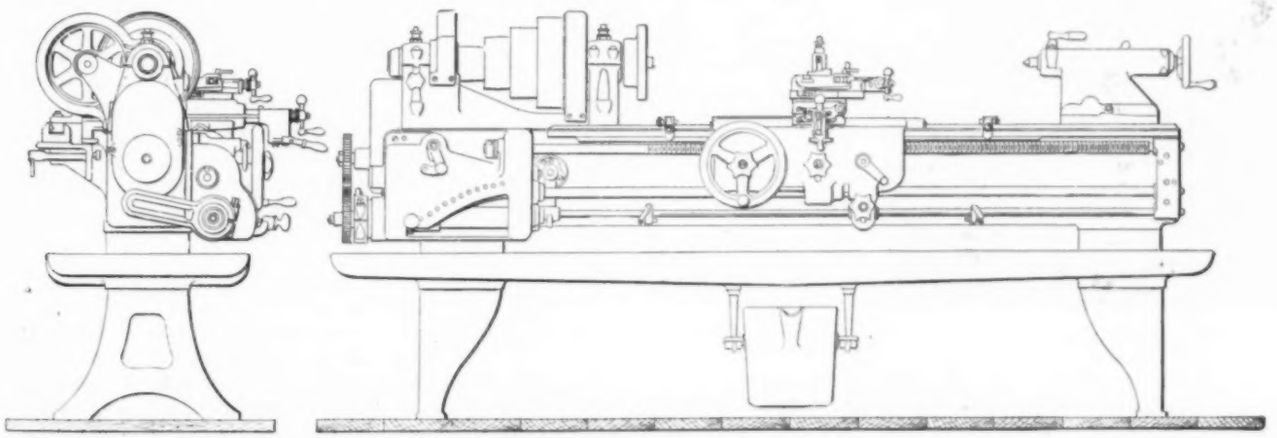

FIG. 3. FRONT AND END ELEVATIONS OF 16-INCH TOOLMAKERS' LATHE

which is shown also in the general view, Fig. 1. This pinion is inside of a sleeve *L*, open at one side, and upon which is mounted a sliding bracket operated by arm *M* and carrying an intermediate gear

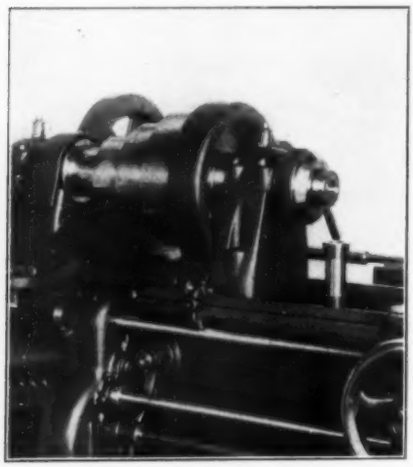

FIG. 4. SHOWING METHOD OF HOLDING SPRING CHUCKS

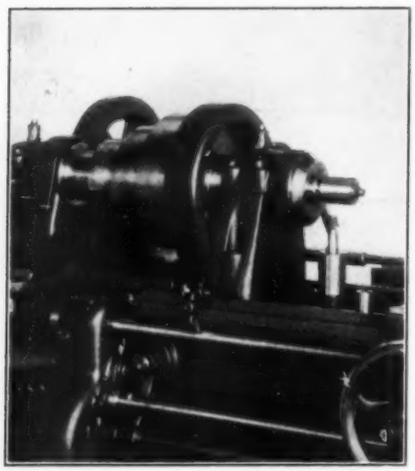

FIG. 5. SHOWING EXPANDING BUSHINGS AND OPERATING PLUG

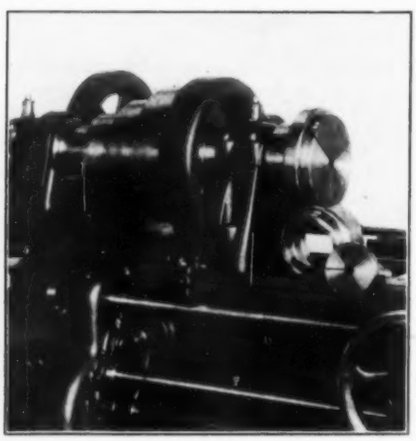

FIG. 6. STEP CHUCKS AND CLOSERS

N which meshes always with the long driving pinion, and which may be engaged with any of the twelve gears in the cone *O* by drawing out the handle in arm *M* and shifting that member along to the required point. As the sliding bracket is keyed to the sleeve the sleeve rocks with the bracket when the latter is moved. The locking of the arm is accomplished by a series of projecting pins, which fit a hole formed in the inner end of the spring plug in the handle. A shallow bell-mouthed channel milled across the end of the plug forms a guide groove for facilitating the locking of the plug on the required pin. The gear cone is geared as shown at its inner end to the lead screw *P*, and to the splined feed-rod *Q*; and it is obvious from the drawing and from what has been set forth in this and the preceding paragraph, that 24 rates of feed for the carriage for either screw cutting or turning may be obtained by means of the two controlling handles on the gear box, without shifting the change gears through which the box mechanism is actuated.

The 12 locking pins projecting from the front of the gear case are stamped on their faces in accordance with the number of teeth on the corresponding gears in the cone, and index plates on the head show the positions of shifting handle *M* and the upper handle *J* for any desired feed in the range of the lathe. These plates are represented in Figs. 9 and 10, and it will be noticed that formulas for gearing up for odd threads are provided at the bottom of the thread-cutting index.

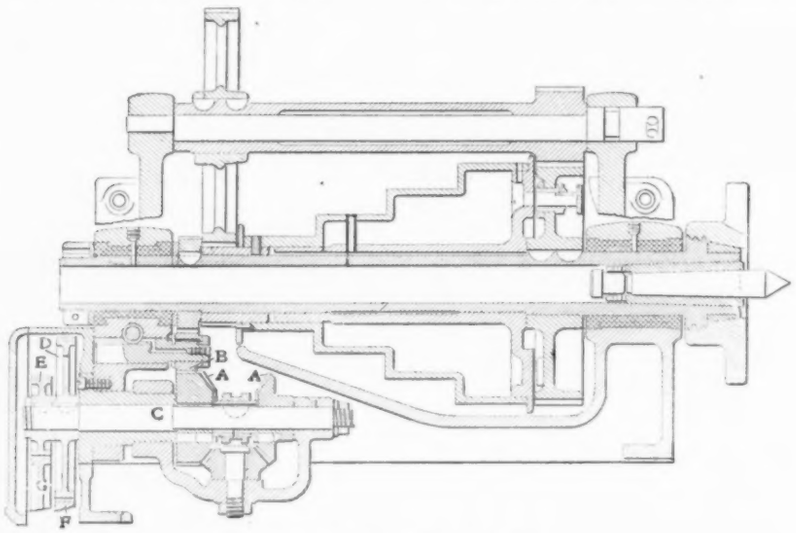

FIG. 7. SECTION THROUGH HEAD

THE CARRIAGE.

Considering now the carriage itself, it will be observed from Figs. 11 and 12, which show respectively a front elevation and a cross-sectional view of that member, that the bearing surfaces upon the bed—which is of stiff box section as indicated—consist of a V in front and a flat way at the rear, while the inner ways upon which the head and foot stocks rest are the reverse of this, consisting of a flat surface at the front and a V at the rear. As shown, the carriage has ample depth of bridge, secures a long bearing upon the shears and is well gibbed to the outside of the bed. The arrangement of the gearing in the apron for longitudinal and cross feeding is clearly indicated in the two drawings. The split nut for engaging the lead screw is shown at *A* and the hand device for stopping and reversing the feed at *B*. The knob shown is connected by gears to a rack formed in the under side of rod *C*, and this rod, which is shown at *R* in Fig. 8, is attached at the end, as represented in that drawing, to a rock lever *S*, which by means of a link and a yoke controls the clutch between the two bevel reversing gears under the head. A spring plunger at *T*, Fig. 8, holds the clutch central, or in engagement with either gear until end pressure is applied to the rod, either by the hand knob or by the carriage stops. These stops are shown in place on the rod in the halftone, Fig. 1; the right-hand stop is also represented in position in Fig. 11. The method of adjusting will be apparent.

THE TOOL SLIDE.

The carriage section, Fig. 12, reveals some interesting and ingenious features in connection with the tool slide. One of these, which is of especial convenience when cutting threads, is the quick-action device for withdrawing the tool and again bringing it forward to former position without turning the cross-feed or compound-rest screw except by the slight amount necessary for each successive chip. It will be seen that the cross-feed screw takes a bearing at its front end in a sleeve *D* arranged to slide in bracket *E* which is secured to the end of tool-slide guide *F*. At *G* is a stud with an eccentric at the top, engaging a shoe in sleeve *D*, and with gear teeth at the lower end meshing with teeth on the hub of handle *H*. When this handle is moved to the right, the sleeve *D* and the tool slide and screw are all drawn back, to be moved forward

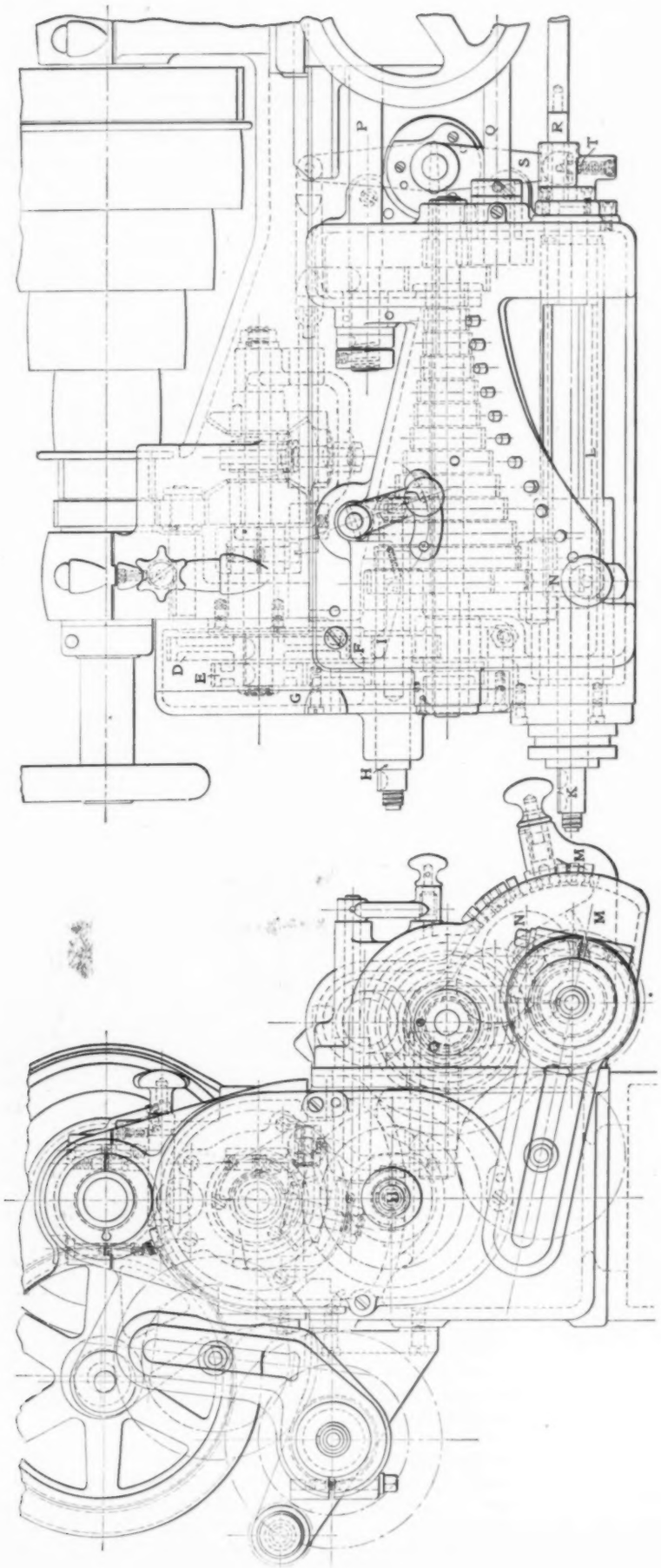

FIG. 8. END AND FRONT ELEVATIONS OF HEADSTOCK AND GEAR BOX

to their original position upon again throwing the handle to the left. The handle has a shoulder at either side of the boss which strikes a corresponding surface on bracket *E*, thus forming a positive stop when moving the tool rest either in or out. The movement obtained in this

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THREAD CUTTING INDEX

CHANGE GEARS						
80 to 40		80 to 80		40 to 80		
Thds. Per Inch	Upper Lever	Thds. Per Inch	Upper Lever	Thds. Per Inch	Upper Lever	Lower Lever
1½	Right	3	Right	6	Right	24
1⅝		3¼		6½		26
1¾		3½		7		28
2		4		8		32
2¼		4½		9		36
2½		5		10		40
3		6		12		48
3½		7		14		56
4		8		16		64
4½		9		18		72
5		10		20		80
5½		11		22		88
6	Left	12	Left	24	Left	24
6½		13		26		26
7		14		28		28
8		16		32		32
9		18		36		36
10		20		40		40
12		24		48		48
14		28		56		56
16		32		64		64
18		36		72		72
20		40		80		80
22		44		88		88

CHANGE GEARS						
40 to 92		80 to 92				
11½	R	11½	R			40 80

FORMULA FOR ODD THREADS

LET R = RATIO OF CHANGE GEARS
" P = NUMBER ON PIN
" T = THREADS PER INCH

$R = \frac{P}{2T}$ WITH UPPER LEV. LEFT

$R = \frac{P}{8T}$ " " " RIGHT

EXAMPLE

TO CUT 11½ THREADS PER INCH

ASSUME LEVER AT RIGHT

" P = 80

$R = \frac{80}{8 \times 11\frac{1}{2}} = \frac{80}{92}$

PAT., JULY 18, 1905.

FIG 9. THREAD-CUTTING INDEX

way is about one-half inch and the device is obviously as serviceable for internal as for external threading. For setting in for each successive chip, the micrometer dial and screw are, of course, used in the customary fashion, their adjustment being in no way disturbed by the withdrawing or return of the tool slide.

The device is pretty well shown also in Fig. 13 which gives an excellent idea of the appearance of the carriage and its attachments, one of these being the compound elevating tool rest, and another the follow rest, which, as represented, is gibbed to the tool-slide guide.

COMPOUND ELEVATING REST.

A section through this rest is given in Fig. 12, while plan and elevation are shown in Fig. 14. From these two line drawings and the half-tone, Fig. 13, it will be seen that the rest is mounted upon a swiveling plate—the cut-away style of footstock permitting the rest to be swung well around—while the member carrying the tool post is adapted to be rocked up or down, through a certain angle, to elevate or depress the tool. This part is seen at *I*, Figs. 12 and 14, and as therein depicted it takes a semi-cylindrical bearing in body *J*, the bearing surfaces at the sides or ends, which retain rest *I* in its seat and take the side thrust, being of conical form. Arm *K* is formed integrally with *I*, but the opposite arm *L* which must necessarily be attached after the adjustable rest is placed in its seat, is secured in place by three fillister head screws and as many dowels. The inner faces of the two arms fit snugly against the corresponding faces of body *J* and through-bolt *M* clamps all fast when the tool is adjusted to the desired hight.

The stepped collar on the tool post is utilized to bring the tool approximately to hight, then by releasing the nut on the clamping bolt, the rest is tilted by means of ear *N* to bring the tool to final adjustment.

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FEEDS

LONGITUDINAL FEEDS	UPPER LEVER	CHANGE GEARS
0097 to 023 0259 to 002	LEFT RIGHT	80-40
0031 to 012 0125 to 046	LEFT RIGHT	80-80
0015 to 006 0097 to 023	LEFT RIGHT	40-80
CROSS FEEDS		
0056 to 021 0224 to 082	LEFT RIGHT	80-40
0028 to 010 0112 to 041	LEFT RIGHT	80-80
0014 to 005 0056 to 021	LEFT RIGHT	40-80

FIG. 10. FEED PLATE

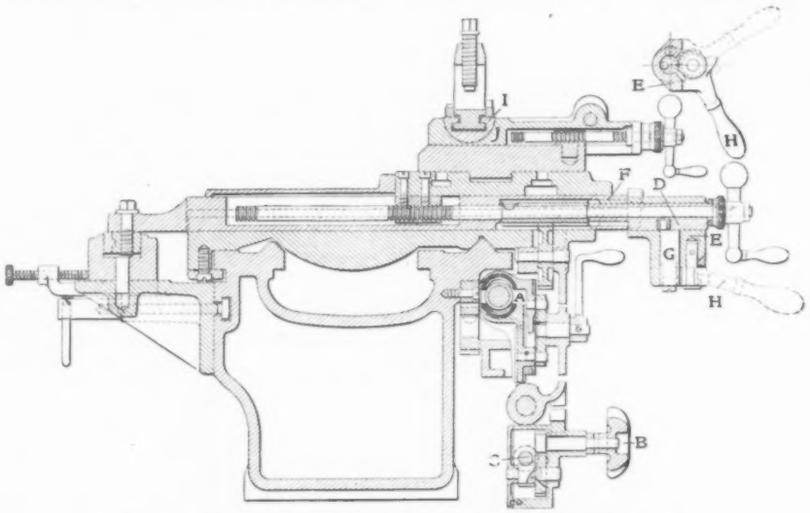


FIG. 12. CROSS SECTION THROUGH BED, CARRIAGE AND APRON

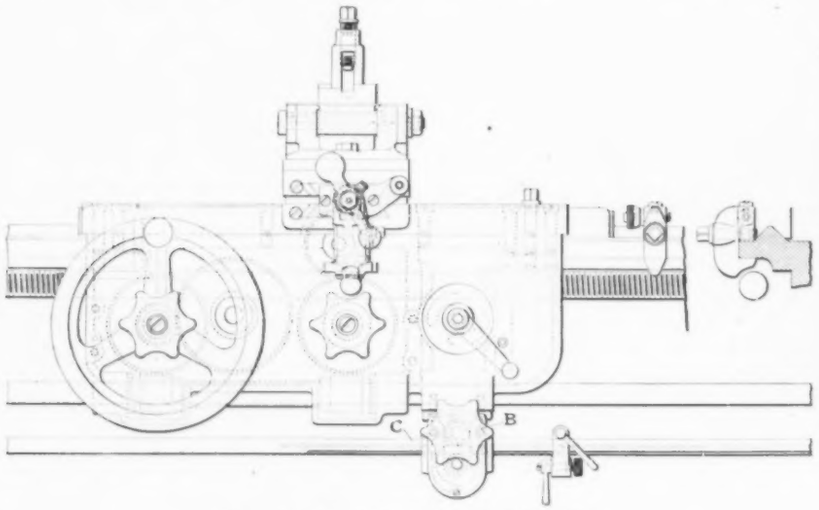


FIG. 11. FRONT ELEVATION OF CARRIAGE

MICROMETER STOP.

In several of the half-tones already referred to a micrometer stop for the carriage will be noticed clamped in position on the bed. This attachment is also illustrated in the carriage elevation, Fig. 11. Photographic views of front and back of the stop are reproduced in Fig. 15. As there illustrated, the body, which is a solid forging, is fitted with a shoe having an inclined bearing at the top and when drawn back into its seat by the clamping bolt it draws the stop up squarely and firmly to the front of the bed. The micrometer screw is of substantial size and the nurled head plainly graduated for easy reading.

THE TAPER-TURNING ATTACHMENT.

This attachment is shown in Fig. 2, and a cross section is given in the carriage drawing, Fig. 12. The device may be set without the use of a wrench, clamp handles being provided for locking it at the desired point along the bed, and also for holding the taper bar at the required angle, the setting of the bar itself being accomplished with nurled-headed adjusting screws. One end of the bar is graduated to read in tapers per foot and the other is graduated in degrees.

FIG. 13. SHOWING CARRIAGE AND COMPOUND ELEVATING REST

THE RELIEVING ATTACHMENT.

The relieving attachment, which also is shown in place in Fig. 2, need not be described here in detail as a full account of the construction and use of this device as applied to the 14-inch lathe of the same

make was given at page 231 by F. O. Hoagland. It may be stated, however, that the cam fixture is mounted on the taper bar and the cam shaft which it carries is actuated by a telescopic shaft from change gears at the rear of the head. The cam

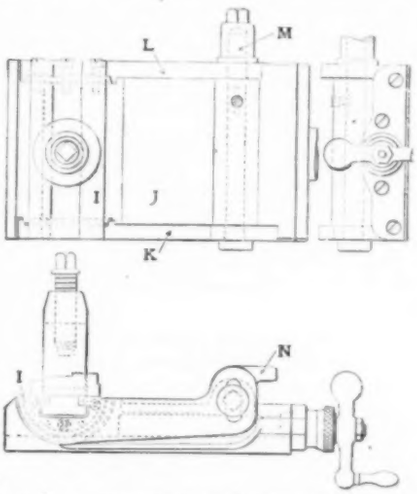


FIG. 14. COMPOUND ELEVATING TOOL REST

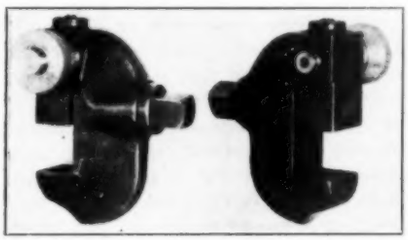


FIG. 15. MICROMETER STOP

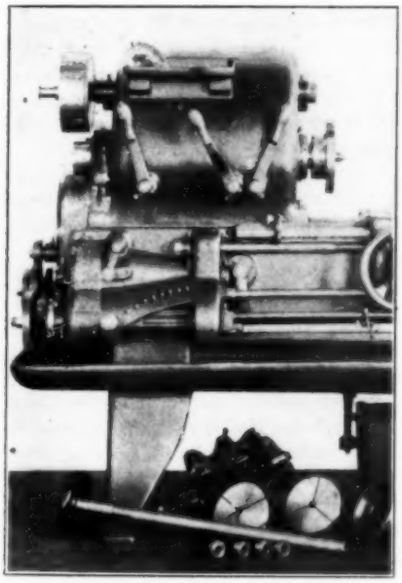


FIG. 16. GEARED HEAD ON 16-INCH TOOL-MAKERS' LATHE

acts against a roller carried in a slide attached to the cross slide and draws the slide and tool back for the relieving cut and a spring returns the slide and tool as each tooth is passed. The device is practically self-contained except for the telescopic connection to the driving gears, and the cams, which are of various shapes and throws to suit different classes of work, are readily changed, one for another. A plate attached to the casing gives the gears required for backing off any number of teeth; and the attachment may be used for relieving both straight and taper work, and work with either straight or spiral flutes.

THE GEARED HEAD.

The geared-head lathe referred to at the opening of this article is illustrated in Fig. 16 and a lay-out of the internal mechanism is represented in Fig. 17, which is a longitudinal section through the several shafts, gears, and spindle. The latter in general is of the same dimensions as the cone-driven spindle, but runs in bronze boxes which are split and adjustable for wear, the means of taking up being clearly indicated.

The drive is taken from the two-speed countershaft by the plain belt pulley, which is 10 inches diameter by 3 inches face, and transmitted through the gears and friction clutches to the spindle, the speed range of which varies from 10 to 450 turns per minute, the total number of speeds being 16. The three levers at the front of the head control the speeds through the friction clutches which may be instantly operated without stopping the belt. The three clutch-controlling rings are shown at *A*, *B* and *C*, with friction gears at either side, and it is obvious upon inspection that, for each speed of driving shaft *D*, shaft *E* has two rates of speed, shaft *F* four rates, and shaft *G* twice the latter number, or eight speeds.

Ample provision is made in the design for keeping all running parts in the head well lubricated. Where lubricant is to be used upon the work, a pump may be driven from the small pulley shown at the outside of the main driving pulley, in Fig. 16. As in the case of the other lathe shown, the pan formed with the bed takes care of all lubricant and chips, and the tank suspended on trunnions underneath forms a handy receptacle, as it may be easily emptied when necessary.

MOTOR DRIVE.

In the design of the geared-head lathe, provision has been made for the easy application of an electric motor for driving and an outline drawing, showing the general scheme of mounting the motor and connecting to the main shaft in the head, is reproduced in Fig. 18. The drawing is self-explanatory.

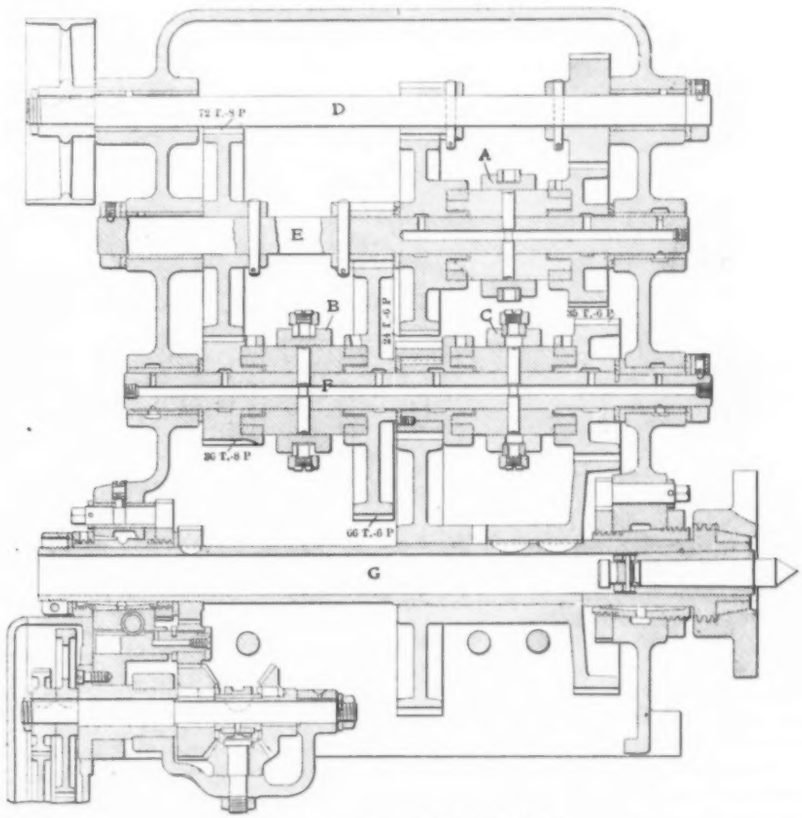


FIG. 17. GEARED-HEAD MECHANISM

GENERAL DATA.

Besides the dimensions and particulars as to speeds, etc., already given, the following data may be of interest:

The swing of the lathes illustrated, over the ways, is 16½ inches; over the carriage, 10 inches. The length taken between centers with 6-foot bed is 33 inches. The screw-cutting feeds provided for, as noted on the plate attached to the head, range from 1½ to 88 threads per inch, including 11½; the feeds for turning range from

0.0015 to 0.092 inch per turn of spindle; the cross feeds from 0.0014 to 0.082 inch per turn. When metric threads are required to be cut a gear box is provided, giving a range of from 0.5 mm. to 15 mm. lead.

The set of spring collets regularly included in the equipment hold stock ranging in size from ⅜ to 1¼ inches, and the expansion bushings range in diameter from ¾ inch to 2 inches. The step chucks which are supplied blank are suitable for boring out for work ranging from 1¼ to 6 inches in diameter.

An Attachment for Turning and Threading the Ends of Long Work in the Lathe

One of the jobs common to wherever the search for oil is going on is the threading of the boxes and pins which are used to couple the string of tools together.

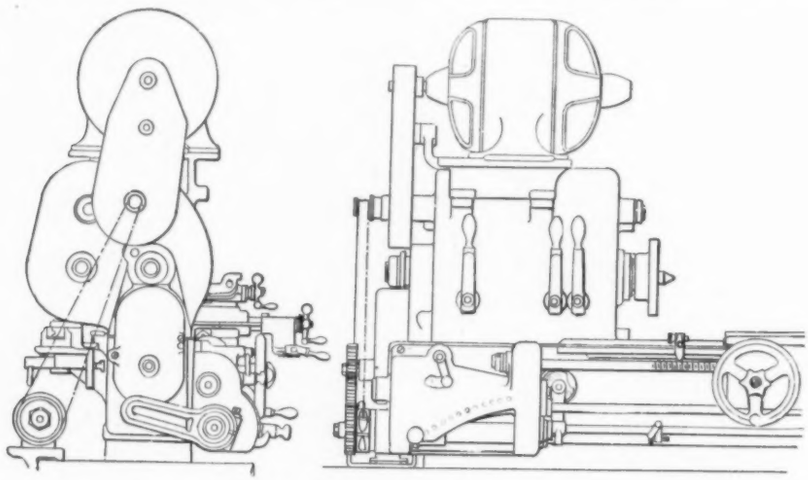


FIG. 18. MOTOR DRIVE FOR LATHE

Many of the tools are short and these parts are threaded after the blacksmith work is all completed, but in making the auger stems, which are made up to 48 feet in length it has always been the custom to finish up the boxes and pins before they are welded on, and it is still the custom. They have to be welded on anyhow and so it is almost as easy to finish them up first and do the welding afterward as it would be to do the lathe work last, as far as the blacksmith is concerned, and it goes without saying that it is very much easier for the machinist.

In use these boxes and pins become worn so that they are not a proper fit and have to be re-threaded, or they will seize in the threads and part will strip from one and stay in the other, or they will get damaged in the handling so that the necessity of re-threading is a common one.

The ordinary way to do this is to cut off the box or pin that needs to be re-threaded, do the necessary lathe work on it and then weld it back on again. To be able to have this job done the stem has to be taken to a shop that has the proper facilities. This means a steam hammer in the case of the blacksmith shop and a lathe with a taper attachment in the case of the machine shop. Often it costs a great deal more to haul the stem to the shop and back again than it does to do the work at the shop.

Lathes have been built that would do this work without the necessity of cutting off the box or pin. They would be built with a very large hollow spindle. To do the largest sizes of these stems requires that the hole through the spindle be something like 7 inches diameter, and anything under 6 inches would not be of much use. There are at least two objections to such a lathe. In the first place it has to be built special, which makes it very much more expensive than a regular one of the same swing, and in the second place it is an inconvenient tool for ordinary work. The re-threading of the stems takes but a small part of the time of the lathe and very few shops can afford to have them idle during the balance of the time.

One shop where they have all the facilities for welding have still found it cheaper to avoid doing it and have made a very cheap attachment that allows them to do the re-threading on an ordinary lathe. The idea might be used on other long work.

This attachment consists of a sleeve that has a hole through it large enough to take the largest stem. It has a bearing at each end. These bearings are made to fasten to the ways in the same way as a steady rest and bring the sleeve so that its center coincides with the lathe centers.

On the end of the sleeve nearest to the headstock is fitted a chuck and a gear is mounted on the outside. A small shaft with a pinion on each end of it furnishes the drive. One of these pinions meshes into the large cone gear of the lathe and the other one with the gear on the sleeve. There is a bearing for this shaft as part of the bearing for the sleeve and a bearing made to clamp onto the headstock holds the other end. An adjustable roller support holds the outer end of the stem being operated on.

In doing a job the lathe is worked in the usual way except that the work is at the right of the workman instead of at the left. I can imagine that an old latheman would have some peculiar sensations the first few jobs he did with this device. That it is thoroughly practical is shown by the statement of the owner that it could be put on and a pin re-threaded in an hour and a quarter. As the usual charge there is six dollars for cutting off a pin, re-threading it, and welding it back on, it can be seen that it would not take long for it to pay for itself. I understand that the cost of making it was less than one hundred dollars.

The pins threaded in this way are sure to be in line with the stem and there is no fear of a bad weld.

It will be understood that the tailstock is removed to allow for this attachment being used, and that the carriage is between it and the headstock. Where large pipe has to be threaded and a pipe machine large enough to handle it is not at hand, it is much more convenient to use than it is to catch the end of the pipe in the chuck while the body of it runs in the steady rest. Besides saving something in the length of the pipe it avoids the annoyance of having the pipe crawl endwise, which it is very liable to do if caught in the chuck jaws. Unless a piece is fitted into the end of a pipe that is caught by the end in a chuck it is very liable to be crushed out of shape; and unless a considerable piece is cut off, the thread will not be round when finished. In using this attachment the pipe is caught so far from the end that it is much more rigid than when caught at the end, and it is also farther removed from the end so that there is not much danger of the end being affected.

It is a job-shop rig and there is no doubt that the job-shop man will see a number of applications on jobs where long pieces need to have work done on the end.

W. OSBORNE.

Those who have read our series of articles on the Russian industrial situation will probably be interested also in a small pamphlet publication entitled, "A Great Iniquity," by Leo Tolstoy, published by The Public Publishing Company, First National Bank Building, Chicago, Ill. In this Count Tolstoy gives his idea of what is fundamentally wrong with Russian industrial life.

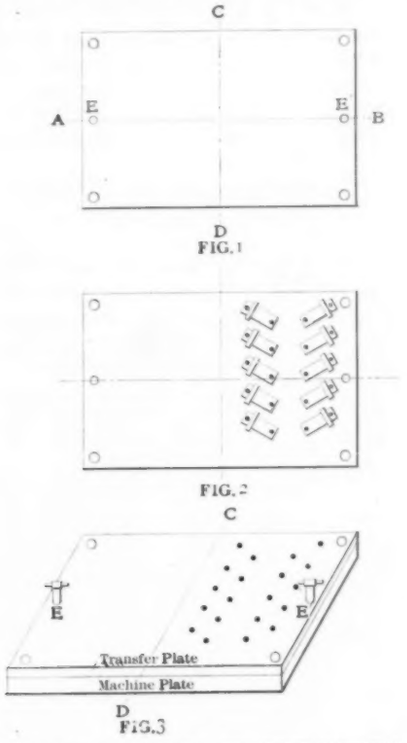
A new feature of the iron market is the considerable purchase of foreign foundry iron which is being made by various manufacturing concerns, particularly by the International Harvester Company. This foreign buying, we understand, is done for a double purpose—the iron is obtained at a somewhat lower cost, and somewhat better deliveries are obtained.

CORRESPONDENCE

Discussing Phases of Machine Design and Construction

Mounting Patterns for Split Pattern Machine Molding

At page 626, Vol. 29, Part 2, you published an article on Mounting Patterns for Split Pattern Machine Molding. Although the method described is a good one (I used it myself for several years), I wish to say that I have discarded this way entirely on account of the amount of labor attached to it, especially if the patterns are to be gated from the side. Instead of using a half plate for the transfer, I use a plate the same size as the machine plate.



MOUNTING PATTERNS FOR SPLIT PATTERN MACHINE MOLDING

The first thing necessary in preparing a set of patterns of this kind is to make the pattern plate to fit the molding machine. Then make a transfer plate the same size as the machine plate. This plate can be made of cast iron about 5/16 inch thick. Drill the transfer plate with the same jig that was used in drilling the machine plate. Lay off the transfer plate by ruling the lines *A B* and *C D*, dividing it into four equal parts, as shown in Fig. 1. The plate is now ready for laying out the patterns for end or side gating. Having the full-size plate before you, you can shift the patterns around so that you can see which is the best way to gate them, from side or end; also which way you can get the most patterns in the mold, this being a very important item.

After numbering and finishing the patterns, place the halves without the dowel pins on one side of the transfer plate, as shown in Fig. 2. Now take a piece of rod about 2½ inches long, which fits the holes in the patterns snugly, and dip the tip in red lead and mark off each hole in the patterns on the transfer plate; remove the patterns and center-punch these red dots. Place the transfer plate on top of the machine plate and insert the dowel pins in the holes *E* and *E'*, as shown in Fig. 3, to hold the plate rigid, and drill the transfer plate and the machine plate at the same time. In order to lengthen the life of the transfer plate, drill through it with a small drill, say No. 48, so the drill will just begin to enter the machine plate; then take the transfer plate off and drill the machine plate with the proper sized drill. This will be appreciated after you have used the same transfer plate for a number of jobs and it begins to get full of drill holes.

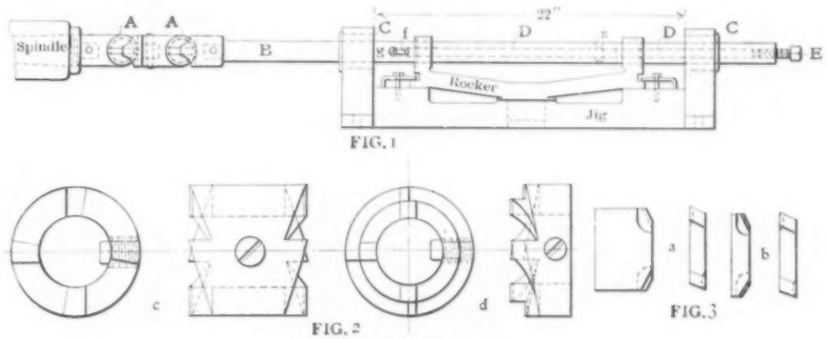
The transfer plate is then turned over on the machine plate; then, using line *C D* as an axis, reinsert the dowel pins and drill the pattern plate, using the transfer plate this time as a jig. Remove the transfer plate, and the pattern plate is ready for the patterns to be attached. Care must be taken in mounting the patterns so that the corresponding halves will be opposite each other, and the casting after molding will be perfect. This is a cheaper way than the one described in the article referred to, and it is just as easy with this method to make patterns gated from the side as from the end.

W. S.

Boring Bars and Cutters

The boring bar shown in Fig. 1 is a bar that gives satisfaction, and has features that warrant consideration from those who want a boring bar for accurate work.

This bar was made for use on the work shown in the jig which is a rocker for the 4-inch sight for the navy. The holes must be in line or they will not do. It was found that with this jig and an ordinary bar the work was not always satisfactory. If the jig was not in perfect line with the spindle of the machine, the bar would spring and the work would be out; consequently the operator would spend hours lining up. *A A* are two universal joints that make the bar *B* flexible, allowing the hardened bushing *c c* of the jig to govern the bar independently of the spindle, so that if the jig is right the work must be. With the universal joints on the bar it is not necessary that everything should be just so: the table can be out, the jig not in line—in fact, near enough is all right.



BORING BAR AND CUTTERS

For securing the cutters, the bar is made hollow with threads for a long screw *e* in the end of the bar. The pieces of steel *D D* are a sliding fit, and of the proper length to clamp the cutters by means of the screw *E*. *S S* are hardened screws to take the wear of the cutters. The cutter shown in Fig. 3 at *a* was found more satisfactory than one with a gib. The cutting edge is the same angle as a twist drill and about the same clearance. It is clamped lightly with the screw *E* and the cut started, when it will center itself. It is then locked firmly to prevent shifting when sand or blow holes are encountered.

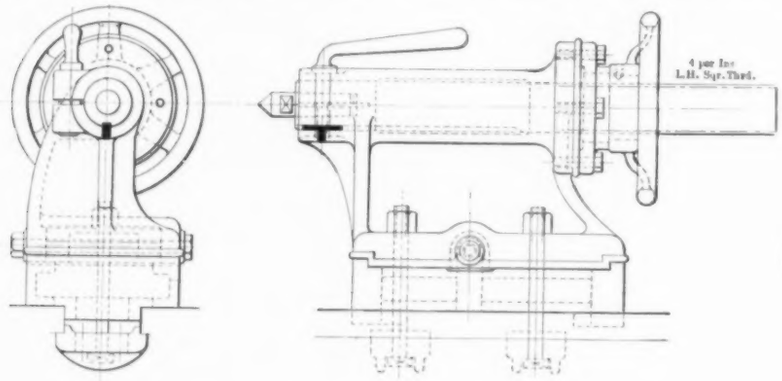
Another bar that is all right is one that has the same means for securing the cutters *b*, which are simply 5/16 inch square,

self-hardening steel, instead of the flat cutter; and, as it only requires a 5/16 inch square hole, it is a much cheaper device. In Fig. 2, *c d* are facing cutters: *c* is for a straight face, *d* is for one with a counter bore. They are secured to the bar by means of the set screws shown. These cutters give a true face, have more cutting edges than an ordinary cutter, last longer, are easier to set and are ground as readily as an end mill. The cutting edges are staggered to prevent chattering.

J. J. S.

Tailstock Design

It must be ten years since I first saw an eccentric clamping motion similar to the one shown at page 513 and credited to Professor Sweet. I cannot say how they worked in practice, but I have seen a considerable number of the ordinary type, with the eccentric at right angles to the spindle, and I cannot say that I am struck with the idea. The throw of the eccentric was about 1/16 inch and the centers were 90 degrees at the points, which would not give as good a result as 60 degrees centers. It was practically impossible to hold the tailstock under a heavy cut; in fact, a bolt was afterward incorporated with the design, so that for heavy work all would not depend on the eccentric. I believe the Berlin firm of Ludwig Loewe & Co. make all their engine lathes (which range from 13 to 28 inches swing) with eccentric clamps to the tailstock.



AN ENGLISH DESIGN OF TAILSTOCK

Mr. Fish, referring at page 675 to the fit of the tail spindle, says: "If it is well fitted, there will be no appreciable give of the spindle at the back end, where it is not clamped." I should like to know how "well" fitted he means, and how he makes his holes (making holes sounds a bit primitive, but I think it is the making of round, straight, standard holes that costs the most money in comparison with the grinding of the pieces to fit therein); in short, what degree of accuracy constitutes a good job, and what kind of reamers, etc., are used in making good on the job?

An idea which may be new to some, and which certainly saves time, is to either core or bore the rear half of the tailstock barrel slightly larger than the spindle, so that there is practically only half the length of bearing. When this is done, it minimizes the effects of a twisted hole without decreasing the efficiency of the tailstock.

Our practice is to bore the tailstock out with bar and cutters in the usual manner, leaving about 1/32 inch for reaming. The first reamer, which is used in the machine, has cutting edges as long as the hole to be reamed and leaves the hole a few thousandths small. The tailstock is then removed from the machine and reamed to size by hand with an adjustable reamer.

The spindles are ground to fit on a Brown & Sharpe grinder, and I may say here that up to the present time I have not been able to get a free-fitting spindle which did not lift appreciably when only about two inches in its hole.

It is possible, without much difficulty, to make a spindle with which, if the hand be placed over the rear end of the barrel and the spindle be pulled about halfway out, the vacuum will be sufficient to cause it to spring smartly back when released; but, at the same time, if the spindle be pulled out till it has only about two inches of bearing, there will be a perceptible shake. Is this allowable? If not, how can it be remedied without taking an undue amount of time?

I might say, as an example of what we do at present, that four tailstocks, having a barrel 16 inches long, were reamed and the spindles fitted in 2½ hours. The spindles were about 14 inches long by 1½ inches diameter, with 1/64 inch for grinding.

A tailstock which in my opinion is far superior to the ordinary type is shown in the engraving. It is, I think, of an old design; but, anyhow, it is becoming popular in Great Britain. It will be seen that, up to its full travel, the spindle always has a full-length bearing in the barrel, and it is possible to make the barrel less in length for this reason. A chamber can be cored out in the middle so that the length to be bored is not as great; the spindle can be made from a straight bar and is not bored, except for the center, and, lastly, the screw forging is saved. Of course it may be that the thrust cap at the rear has an increased amount of work on it, but taking into account the savings enumerated above and the fact that the spindle has such a good support, I think it will be admitted that this design is far more practical and workmanlike than the usual one.

I should like some information as to the feasibility of, and the best methods of obtaining, interchangeable tail spindles of the ordinary type.

RACQUET.

Yorkshire, England.

An Arithmetical Short Cut

While the squaring of numbers is more frequently that of whole numbers than fractions, it is not infrequently necessary to square halves, quarters and eighths, such as 4½, 7½, etc., 5¼, 6¾, or 3⅜, 8⅜, or 9⅝, 2⅝, or any of these fractions.

Anyone who knows the multiplication table can square instantly any whole number up to 12. By remembering the following rule we can square any of the half numbers up to 12½ with equal facility.

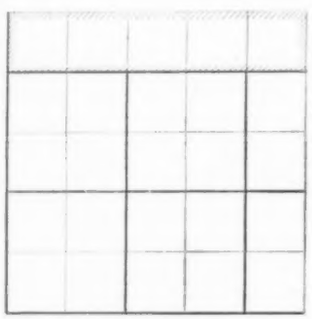


FIG. 1

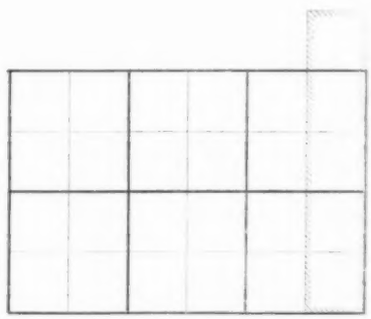


FIG. 2

PROOF OF THE RULE FOR SQUARES

Assume it to be desirable to multiply 7½ by 7½; simply multiply 7 by 8 and add ¼: thus $7 \times 8 = 56$, and $56 + ¼ = 56¼$, the answer. Or the value of $4½ \times 4½$ is found thus: $4 \times 5 = 20$, and $20 + ¼ = 20¼$. To do this requires no pencil or paper, and all that needs to be remembered is to add ¼. In like manner, though not so readily, the numbers with odd quarters may be squared; say, to find the value of $4¼ \times 4¼$

multiply 4 by 4½, which is 18, then add 1/16, which gives the right answer—18 1/16. This works out correctly whatever the odd quarter, and all that is necessary is to add 1/16, which, too, can be done without pencil or paper.

Similarly the odd eighths can be multiplied, but not so readily, except in the case of some numbers such as 7⅞ or 2⅛. Thus multiplying 7¾ by 8, we have 56+ (¾ of 8 or) 6 = 62, to which add 1/64, making 62 1/64, the answer. Or 2⅛ × 2⅛ is 2 × 2¼ = 4½, and 1/64 added, gives 4 33/64, the answer. This, too, can be done mentally, though other numbers with odd eighths are more bothersome.

Anyone sufficiently interested can easily satisfy himself why the additional ¼, 1/16, etc., become necessary by drawing a diagram, Fig. 1, 2½ inches square, dividing it both ways into half inches, then taking a strip off the top and setting it up on end, Fig. 2, from which it will be seen that the result forms a rectangle 2x3 inches, and a half-inch square over, which is one-quarter of a square inch. This may not be new, but it is probably not well known, and it would seem to be worth any mechanic's time to learn, as are all short cuts to results.

JOHN E. SWEET.

Unjust Claims upon Builders of Machine Tools

There are two sides to every discussion. I have known of quite a number of unjust claims having been made on builders of machine tools, and I have also known of just claims that have been made and ignored.

Two friends of mine started a small machine shop. Among the tools they bought was a 24x24x6-foot planer made by one of the best makers in the country. Under the table of this special breed of planer, and cast in one piece with it, is a sort of a flange, or shelf to prevent the chips from falling on the V's through the stop holes. In this particular machine, owing to some defect in the casting, this flange had been planed away, so that chips falling through the stop holes would fall directly in the V's.

Bown came to me after he found the defect, and asked me what he should do. He had bought the planer along with other tools through a dealer.

"Do you owe the dealer any balance?"

"Yes, I owe him a little over $100."

"Then," said I, "you are safe if you only work it right."

A few days later he came back and told me that the dealer had agreed to pay him for the time necessary to fit a sheet-steel flange where the cast-iron one should be. Bown told me he thought this was fair, and wanted my opinion.

"Suppose you put that steel flange on there, and get say $5 for it. You have just started in business; you don't know whether you will be in business six months hence or not. Suppose you go broke and have to sell out. I know that planer is a good one, except for that slight defect. We will say for the sake of argument that the steel flange improves it. The day of the sale arrives; previous to the sale I have dropped quite casually into the various offices of the six or eight dealers in town. We always talk shop on such occasions.

"'Fine lot of tools Bown has.'

"'Yes; all new six months ago; it's a pity about that planer.'

"'Why, what's the matter with the planer?'

"'Well, don't tell anyone I told you; big patch under the table clear from end to end; ought by rights to have a new table; don't mention it—some dealer will get stuck if he buys it.'

"They all get the same hint, of course, not to be repeated. I arrange with a friend, unknown to the dealers, to do my bidding at the sale.

"At the day of the sale another friend takes particular good care to call the attention of all present to the patch. Your explanations, if you hand out any, are not believed; the dealers won't bid on the tool, and it is eventually knocked down to my friend for one-quarter of its value, while the dealers all joke with him and tell him he's stuck.

"Next week that planer is set up in my shop and perhaps you are running it."

Bown went away a sadder but wiser man. I had purposely painted the picture as black as possible—far blacker than it would actually be. Who ever heard of a dealer being afraid of a machine with a *hidden* defect? However, the result was satisfactory to Bown; he was allowed $50 for that defect. I think if I had been the builder of that tool I would have sent him a new planer and taken the defective one back, irrespective of what it cost me.

I once attended a sale at a very large works in a very large city. There were rows upon rows of engine lathes, but I noticed that there were no lead screws on them—merely feed rods. I told my boss about this (he was a dealer), and I buttonholed one of the former employees, who told me that when a new lathe was bought for that department the lead screw was taken out and put in the tool room. He took me to the tool room, where the screws were standing in a corner covered with a thick coat of white lead and tallow, and on top of this, dust, that gave them the appearance of scrap iron.

I borrowed $20 from my boss, after looking at the printed list and finding them labeled as "Lot 726, 28 old screws." When the tool room was sold Dixie got the "old screws," ranging in length from 6 to 21 feet, for a five-dollar bill. After the lathes were all sold, the dealers began to look over their purchases more carefully, and discovered that the lead screws were missing. These they bought from Dixie at 75 cents per foot, and were glad to get them at that price.

A dealer, a friend of mine, had an amusing experience. He sold a speed lathe to an old Dutchman, who had not been in the country long. This lathe, like many others, had a front bearing larger in diameter than the back bearing. The day after the lathe was delivered, the old man came in and said the lathe was no good, as the spindle was "over a quarter of an inch out of line, up and down," and he wanted it taken back. Of course, the dealer *knew* it couldn't be that much out of line, but went with the old Dutchman to see what was the matter. On arriving at the shop he found the spindle bearing caps off and the spindle out. The bottom halves of the bearings were in place. The old fellow took a steel straight-edge and laid it edge down on the bearings; of course, as the back bearing was smaller in diameter than the front the straight-edge had a decided slant. It took two hours to partly convince the old man that that spindle was in line with the ways.

Shortly after I started the shop I bought (in a hurry and repented at leisure) a 12-inch lathe. I knew it was a poor tool, but I hadn't given it credit for being as poor as it was. When it was belted up it wouldn't run without the back gears in, so I examined it. The two caps were taken off and the spindle *pried*—yes, *pried*—out with the aid of two pinch bars. As it left the two lower boxes, the front end and back end of the head sprung toward each other with a loud "*punk*." It was a new lathe and those two ends must have been sprung apart to get the spindle in. Over 1/64-inch had to be taken off the bearings before the spindle would go in again.

I did some work for a concern who had a lathe and shaper of their own. One day when I was in their office the bookkeeper, who ran the tools between adding up columns in his ledger, asked me to step into the shop. The place looked like a display in a machinery dealer's window. The tools were new, bright, and clean. The bookkeeper took me over to the shaper and showed me a *great* invention of his, and asked me if it was patentable. The taper pin in the clapper block was driven in too tight, and as it had never been oiled the clapper block would not drop of its own accord. He had put a rubber band around it to force it to seat, and was highly delighted with his ability as an inventor. I picked up an oil can, tapped the pin out, and oiled the pin and block and put them back in place without the rubber band. He was surprised and disappointed to see the block work without the aid of the rubber band, and strenuously objected to my greasing (that's the word he used) the machine he had to handle. The lathe was also run without oil—hardly what one would call a square deal for the builder. Later on these two tools fell into my hands. The shaper was badly constructed. The cone shaft was supported on its outer end by a bracket. It seemed to me that it

took more power to run that tool empty than it ought, so I took it apart, but could find nothing except that the gears were a little too deep in mesh, which time and wear would correct to a certain extent. On putting the bracket back in place I found that 1/16 inch too much had been planed off the foot of the bracket for the cone shaft. A thin liner corrected this. The manufacturer should have put one in.

DIXIE.

Mandrel for Piston Rings

The illustrations show expansion mandrels for holding piston rings, ranging from 4 to 16 inches in diameter, while undergoing the operation of facing them to width. A gray-iron expansion gripper is required for each size of piston ring. The

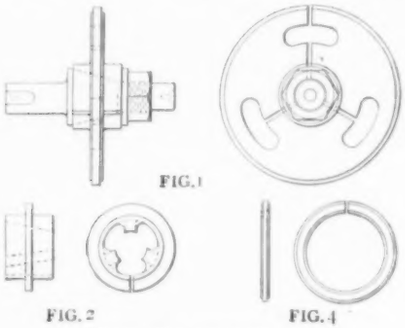


FIG. 1

FIG. 2 FIG. 4

MANDREL FOR SMALLER RINGS

construction of the larger grippers for each mandrel is shown in the assembled views, Figs. 1 and 3, and that of the smaller sizes is shown in Figs. 2 and 4.

The cores or bodies of the mandrels are made of tool steel, and are hardened and ground. The mandrel in Fig. 1 is used for holding piston rings ranging from 4 to 8 inches in diameter, and its grippers are

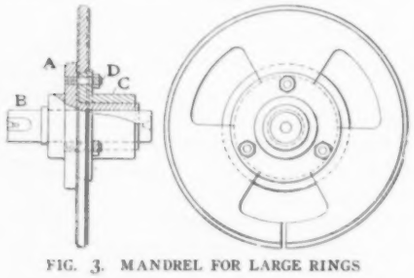


FIG. 3. MANDREL FOR LARGE RINGS

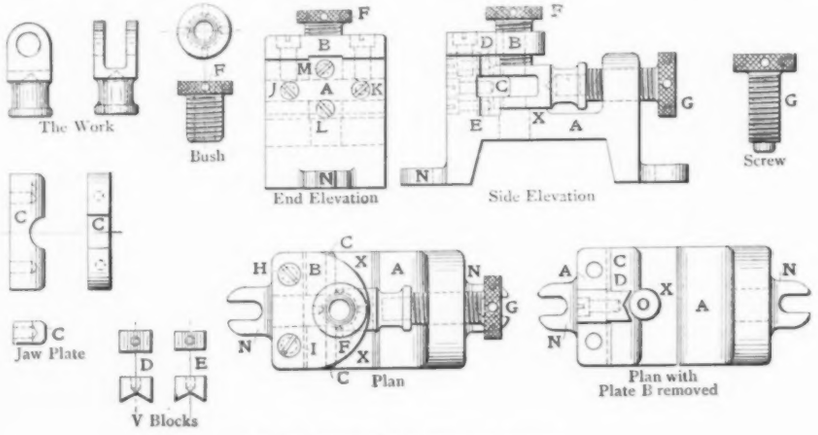
expanded on the cone with the aid of a nut fitted on the threaded part of the body. The mandrel in Fig. 3 is used for holding piston rings ranging from 9 to 16 inches in diameter. The gray-iron part *A* is driven on to part *B*. Part *C*, also made of gray iron, has a sliding fit on the hub of part *A*. The grippers on this mandrel are expanded by tightening the nuts on the studs *D*.

H. E. R. MANBRAND.

Jig for Drilling Knuckle Joints

I designed the jig here shown for drilling knuckle joints for automobile rods, and after about eight months' use we find they are all that can be desired for speed and accuracy, and can be operated by a boy.

A is a gray-iron casting planed on the bottom, and also on the part marked *X*, where the joints are supported when they are being drilled. *B* is a steel plate with a groove at the bottom which fits on the tongue planed on top of *A*, and secured by the two fillister-head screws marked *H* and *I* in the plan. *C* is a mild-steel plate which is a nice sliding fit in the jaw of the joint, which has already been milled to width. This plate is secured to the end of *A* in a groove ⅛ inch deep, as shown in the side elevation, by the two screws *I* and *H* shown in the end elevation. *D* and *E* are two small V-blocks, the top one ⅛ inch longer than the bottom one, for locating the joints central in the jig. They are held in a groove by the two screws *L* and *M* in the same manner as the jaw plate. *F* is the threaded drill bush, case-hardened, which operates through the plate *B* and is screwed down onto the joint, and clamps the latter firmly on the



JIG FOR DRILLING KNUCKLE JOINTS

jaw plate *C* and the planed surface *X*, the clamping screw *G* being first tightened up to force the joint into the V-blocks *D* and *E*. The clamping screw *G* has a reduced end, as shown in the elevation, which fits inside the hole in the shank of the joint, these holes having been previously bored in a capstan lathe. When the joints are gripped with the screw *G* they are quite secure and cannot move, the threaded drill bushing *F* keeping them flat on the surface *X* to prevent any springing. Four small holes for a tommy bar are drilled in the nurled periphery of *F* and *G* for tightening purposes.

The jaw plate *C* is hollowed out in the center, as shown, to clear the drill as it passes through the jaw of the joint; and the hole marked *O* in the plan is drilled through *A*, ¼ inch larger in diameter than the hole in the jaw. This allows the chips to drop clear through and prevents them clogging in the jaw. *N N* are the lugs for bolting the jig to the drill-press table. The end feet of the jig are of sufficient length to allow a small brush to pass under the center of the jig to brush the chips away. This is a very important item which should not be forgotten, as otherwise the jig will soon get clogged up and have to be moved every time and cleaned out before a joint is inserted; and thus much valuable time will be lost.

ROVER.

England.

Boring Cylinders of Automobile Engines

Several interesting features of the latest methods in use for boring cylinders for automobile engines were brought out in a chat with one of the best known builders of boring mills. Feature No. 1 was that while many boring mills were still used for this work, the tendency was to get away from them to something that would give good results and faster time. So the boring mill is to some extent giving way to the large turret for this work.

If this had come from a maker of turrets we would have to make allowance for a partial or incomplete point of view; for in spite of ourselves we are very apt to see things a trifle nearer our own ideas than the other fellow's. But when a maker of boring mills tells you, freely and frankly, that for this small work (they rarely run over five inches in diameter in these days of multiple cylinders) his type of machine is giving way to another, it can be taken without even a grain of salt.

The cylinders are roughed out with an ordinary boring bar having a flat cutter keyed through its center. This bar is held rigidly in the turret and supported at the outer end where possible. This rough bores in very quick time. Then the cylinders are laid aside for a day or so to allow the internal strains of the castings to relieve their pent-up emotions, before being finished in the same machine.

The finishing cut is taken with a two-bladed boring bar which is adjustable for size, but in this cut the bar "floats," being connected through a flexible joint. This produces a good cylinder.

It emphasizes two principles. One is

the best work of this kind cannot be done at one setting, but that the iron must have time to adjust itself before the finishing cut. The other is that for the finishing cut the boring bar must not be rigid.

I. B. RICH.

An Interesting Set of Press Tools

The punch and die here described were made for one of the largest manufacturing establishments in the State of New York. They are used for manufacturing fan-motor regulator rings of which there is a demand for 30,000 daily. As this punch and die are of a rather elaborate type and the work is of a superior quality, a detailed description of the principal working parts may be of interest.

The material used is soft sheet steel 0.014 inch thick. The die is used in a press of the inclined pattern, with automatic roll feed, the finished work sliding into a receptacle at the rear. There are, as will be seen, three dies proper, *A A A*, which are made separately, and then seated in the die-holder *B*. They are arranged in a triangle to use the metal to the best advantage, the result being as shown in the sketch of the scrap stock. Cuts 1, 1, 1 are made at the first stroke of the press, Nos. 2, 2, 2 at the next, and so on; of course, a certain amount of metal is lost at each end of the roll of stock.

The dies *A* are fitted in the cast-iron holder *B*, with four machine screws and two dowel pins, and inside of these dies are fitted knock-out rings like *C*, which have 1/8-inch movement up and down. Underneath these knock-out rings are placed pins *D*, which go through the cast-iron holder and knock-out plate *E* to keep it in position, and rest on a cast-iron plate below, which is not shown. This plate rests on a rubber cushion, and when the die is adjusted in the press the knock-out is up flush with the top of the die. In the center of each knock-out ring *C* an inner section *F* of the die is held with two screws and two dowel pins. The stripping process is assisted by the plate *G*, which is held with three flat-head screws and operated with spiral springs, as shown.

The three punches *H H H* are held in the cast-iron holder *I* with four screws and two dowels, and in the center of each punch is fitted a stripper *J* held in position with three flat-head screws. Three spiral springs are located in seats between the stripper and the punch bed; and the outside stripper *K*, which is also held in place with eight flat-head screws, is forced up in position by 21 springs.

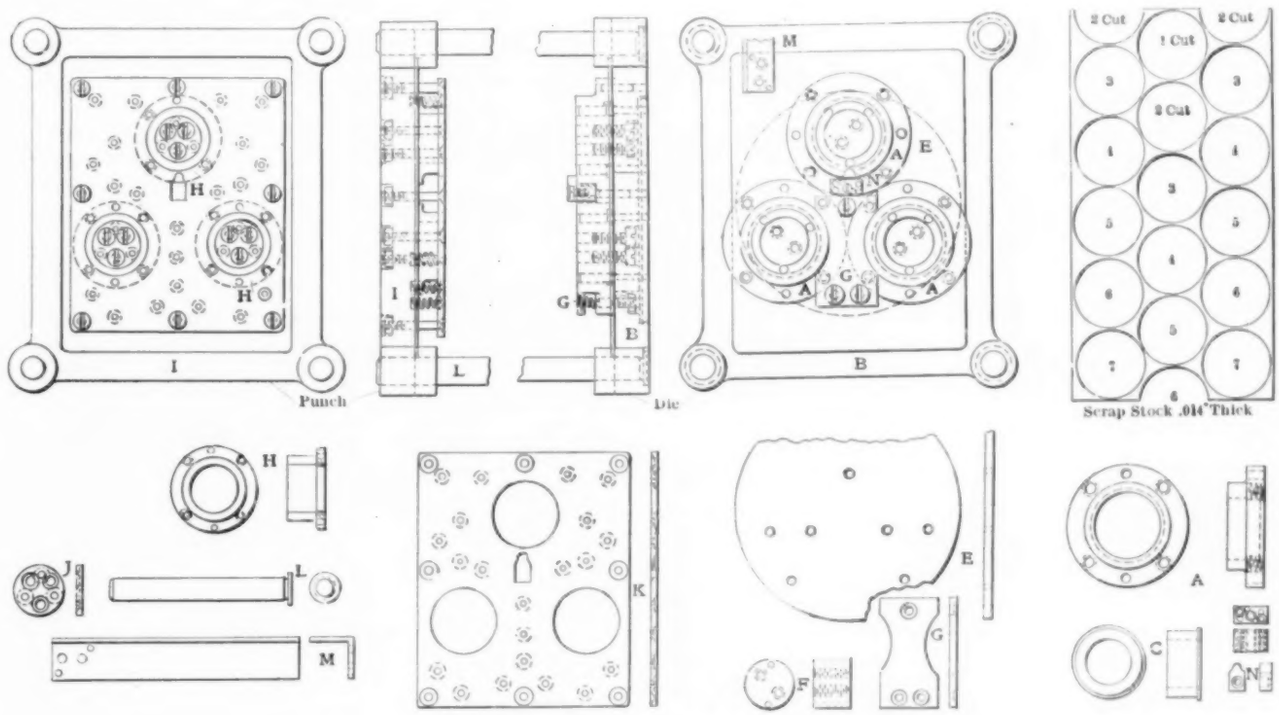
When the punch and die parts are all hardened and ground to size they are put together and the four sub-press-pin holes drilled, reamed, and counterbored to receive the pins *L*. At the left-hand corner of the die is placed a long guide plate *M* which is fastened with two screws and two dowel pins. In the center of the die is fastened a guide block *N*; this is placed 1/16 inch from the cutting edge. A guide pin is fixed at the left side in line with the guide plate, and also 1/16 inch from the cutting edge. As the punch ascends, the knock-out rings *C* plunge upward, and as the press is inclined, the work is thrown out of the punch and die, and drops down the inclined way to the box.

R. A. ALMOND.

Rig for Roughing Out Hammer Dies—Providing for Partners' Widows

Inclosed find a sketch of a scheme used by the machinist who makes the hammer-dies in the shop where I am employed. I do not believe that the sketch needs any explanation other than that the safety pin shown is a loose fit in the hole in the shaper head, acting merely to prevent an injury to the shaper or saw frame, in case a saw breaks. Also, as the saw feeds down, it will saw at an angle unless the head is fed down, which is no trouble in this case, as the man is working on another machine within arm's reach.

In an editorial some time ago, you spoke of an agreement entered into by the members of a company by which, at the death of any of them, their heirs were to receive their percentage of the profits while the estate of the deceased was being settled. This recalls to my mind a contract entered into by the three members of a manufacturing business. Each member was insured for one hundred thousand dollars, the cost of carrying the policies being borne by the business. At the death of the first member, his widow was to receive either the one hundred thousand dol-



CONSTRUCTION OF THE PRESS TOOLS

lars, or one-third of the business, as she chose. At the death of the second member, his widow also was to receive either one hundred thousand dollars, or a third of the business, as she chose. At the death of the third member, his widow was to receive the business entirely, in case the others had chosen the hundred thousand dollars, and in case they had chosen each the third of the business instead of the hundred thousand, she then received also the hundred thousand dollars and the remaining third. This will be an interesting agreement in its settlement, but as all three members are comparatively young men, it will probably be some time before the final settlement is made. S. E.

[This will be quite intelligible without reproducing the sketch, which shows a hack-saw connected by a pin to the head of a shaper with the clapper removed; a weight is clamped near the outer end of the hack-saw frame. The die blank out of which pieces are to be sawed is held in the shaper vise.—Ed.]

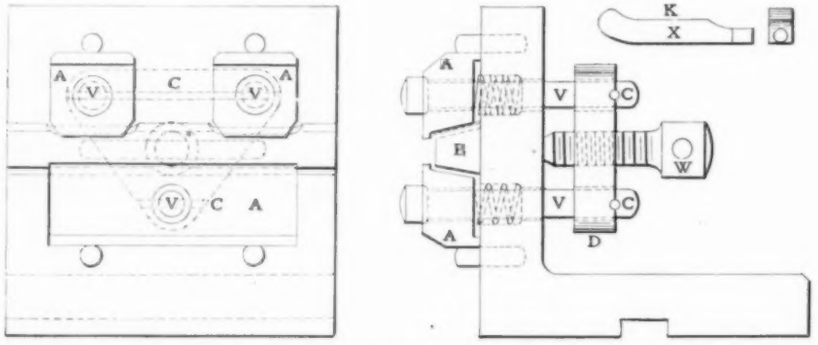
A Pattern Record Card

The card shown herewith is used satisfactorily by a large automobile firm.

When a new pattern is to be made, the blue print is given to the clerk (a draftsman) in charge of the patterns and he issues an order on the pattern shop, designating whether a master or working pattern is to be made. A card like the one shown is filled out with the number, name of piece, drawer number in which the drawing is filed, type, material of which the castings are made, date when the blue print went to pattern shop, and kind of pattern.

When the pattern is completed it is returned to the same clerk, who checks it up from the drawing. The number of pieces in the pattern and core boxes is then recorded on the card. Some patterns have from four to ten core boxes with from one to six or eight pieces, and it is evident that the number of pieces in each core box must be recorded on the record to have it complete.

If the pattern is found to be all right, the date of checking is placed in the space provided for it. The purchasing agent is notified that the pattern is ready for shipment, and he in turn issues a shipping order, of which three copies are made. The triplicate is retained by him, the original and duplicate being sent to the clerk, who then enters on the record, from the shipping order, the foundry to which the pattern is to be shipped and the date of shipment, and sends the pattern and core boxes, together with the original order, to the shipping clerk, retaining the duplicate order.



THE JIG AND THE WORK

When the pattern is returned by the foundry it is delivered to the pattern clerk, who records the date when returned and the condition of pattern. If in bad condition, the word *bad* is placed on the card after the word *condition*. If in bad condition, the pattern is sent to the pattern shop for repairs and the date recorded after the words *in shop;* and on its return from the shop the date is recorded after the word *returned*. Then, if it is to be shipped out again, another order is issued and the same process repeated. If not, the pattern is placed on a shelf in the storage room and the shelf number entered on the card.

It can easily be seen that this card and system show where the pattern is at any time. The pattern clerk has charge of the storage room, the responsibility of recording and keeping the patterns being under one man.

At first glance this system may seem to be complicated; but upon second thought it will be seen that the card contains nothing that is not absolutely necessary, and the pattern is handled no more times than it should be to avoid errors, which would prove costly should the wrong pattern be shipped or a pattern not be correct when shipped. A. B. Hawk.

A Milling Jig

The illustrations show a jig which contains a feature that has proved very effective both for gripping firmly while in operation and releasing the part quickly at the finish. This clamping device may not be entirely new, but it is one that demonstrates its value over the ordinary milling-machine vise, to say the least, especially on thin work.

A A A are three gripping jaws controlled from the back. On this jig two of the castings *X* are milled at one setting; the castings are set in so as to lie in the same direction. The two smaller jaws grip the castings at *K*. The part *B*, on which the castings lie, is held by two fillister-head screws, not shown in the drawing. *C C* are two pins that rest in grooves cut in the strap *D*, which prevents them from turning. They not only look neater, but also give better service than an ordinary cotter pin.

It is obvious that when the screw *W* is

DRAWER NO.	NAME		PATTERN NO.
TYPE	MATERIAL	SHELF NO.	
B / P IN SHOP		CHECKED	
KIND OF PATTERN			
PIECES IN PATTERN		CORE BOX	
SHIPPED			DATE
RETURNED	CONDITION		IN SHOP RETURNED
SHIPPED			DATE
RETURNED	CONDITION		IN SHOP RETURNED
SHIPPED			DATE
RETURNED	CONDITION		IN SHOP RETURNED

FIG. 1. FRONT SIDE

SHIPPED		DATE
RETURNED	CONDITION	IN SHOP RETURNED
SHIPPED		DATE
RETURNED	CONDITION	IN SHOP RETURNED
SHIPPED		DATE
RETURNED	CONDITION	IN SHOP RETURNED
SHIPPED		DATE
RETURNED	CONDITION	IN SHOP RETURNED
SHIPPED		DATE
RETURNED	CONDITION	IN SHOP RETURNED
REMARKS		

FIG. 2. REAR SIDE

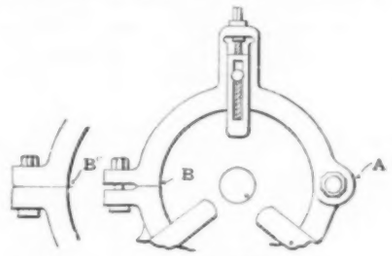
A PATTERN RECORD CARD

screwed up it will draw the pins *V* down, which will cause the jaws *A* to rock toward each other, gripping the work between them and drawing it to a seat on the block *B*. The springs on the pins lift the jaws when the screw *W* is released.

PEDRO.

Taking up the Lost Motion in the Hinge of the Steady Rest

The steady rest as at *B*, you will notice is machined straight across, while the bolt



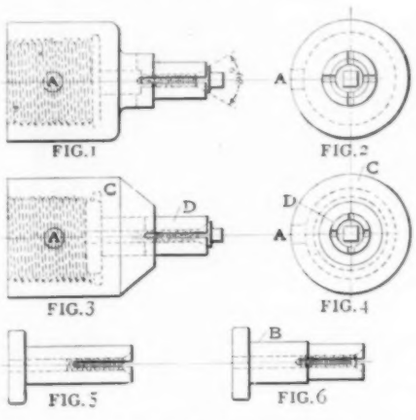
THE STEADY REST

at *A* is usually a loose fit. Therefore to take up the lost motion it requires the upper jaw to be screwed down very tight; whereas if it should be cast or cut away in the manner illustrated at *B*, the mere act of tightening the bolt in *B* would take up the lost motion, at bolt *A*. Thus the upper jaw need only be tight enough to hold the work in place.

A. GREASER.

A Cheap Expanding Mandrel

The expanding mandrel shown in Figs. 1 and 2 was described in a back number of the AMERICAN MACHINIST. Although it is an excellent type, being very rigid and true, it is very expensive to make, as a great amount of labor has to be spent on the large end, which has an internal thread



CHEAP EXPANDING MANDRELS

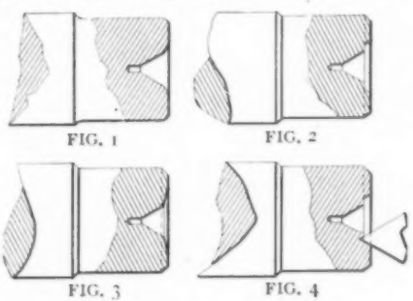
cut in to fit the lathe spindle, and this has to be machined from the solid machinery steel.

I designed the type shown at Figs. 3 and 4, which possesses all the advantages of Fig. 1, and is made for a fraction of the cost. *C* is gray iron, a good fit on the lathe spindle, the hole at the front end being ground to fit *D*, which is a loose interchangeable mandrel, as shown in Figs. 5 and 6. The mandrels are also ground before they are slit up in the miller. This insures a good fit and promotes true running, which is the most important factor. Fig. 6 shows the type of interchangeable mandrel of different sizes, the part *B* fitting the hole in *C*, and the front end being reduced to the size required. By this means a set of mandrels can be made, with only one screwed socket *C*, thus very greatly reducing the cost of manufacture—surely a great consideration—as the business part, which is subjected to all the rough usage, can be replaced at a comparatively small cost. *A* is a ½-inch tommy hole drilled through one side of *C* for the spanner to engage. When the mandrel *D* is put in position, and *C* tightened up against the end of the lathe spindle, it grips *D* tight and gives a firm drive.

England. ROVER.

Centers in Lathe Mandrels

Fig. 1 shows the correct form of dog ends and protected centers for hardened and ground lathe mandrels. During my



CENTERS IN LATHE MANDRELS

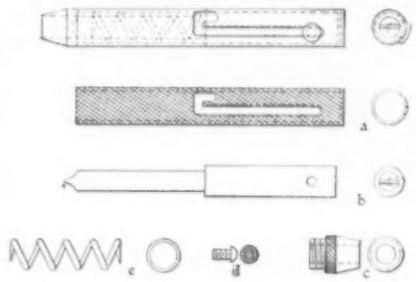
experience as machinist, I have found that lathe mandrels which have their dog ends and centers made up in this way—the ends and the corners at the shoulders rounded instead of chamfered, and the mouth of the centers rounded—will remain true longer and are more easily cleaned than mandrels which have sharp corners at the shoulders, chamfered ends, and so called protected centers, as shown in Figs. 2 and 3, which are the forms of dog ends and protected centers that are common on commercial mandrels. While the two latter forms of centers have protection against blows from hammers and lumpy surfaces on the rams of arbor presses they have no protection against the poor aim of the men who spin the hand wheel on the tailstock of a lathe to advance the tail spindle quickly, and then ram the point of the lathe center against the edge of the mouth of the mandrel center, and raise a lump, as shown exaggerated in Fig. 4. One blow of this kind usually puts a mandrel out of commission for accurate work. A rounded mouth on the mandrel center has no edge to raise a lump on that will throw it out of true.

H. E. R. MANBRAND.

A Handy Screwdriver

The cut shows a neat screwdriver for all-around shop use and especially for automobilists and bicycle riders who have little available space. It can be reduced to the length of the handle by pushing back the button *d*, and a number of blades can be conveniently used with one handle.

To make it, procure a piece of ordinary ¾-inch piping, nurl it on the outside as shown in *a*, and mill an elongated slot in



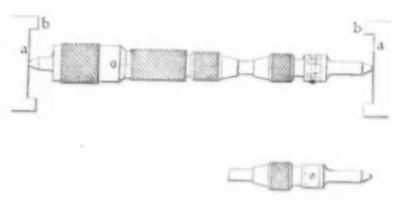
A HANDY SCREWDRIVER

the center on the back part of the handle. Solder a thin plug in one end for good looks. On the other end the pipe is threaded to fit the cap *c;* inside, with an easy fit, is the screwdriver proper, *b*. This is made of tool steel and turned down to any size wanted. On the end is a tapped hole with a free fit for the button screw *d*. Between the shoulder of the screwdriver and the cap is a spiral spring which keeps the screwdriver in the handle when not in use. To use, push the button out to the end and turn it to the right. When not in use, turn the button to the left and the screwdriver goes back itself. When changing sizes, unscrew the cap and button screw, which has a free fit, and the change can be easily made.

JOHN C. MONRAD.

A Gage for Eccentric Straps and Similar Work

The illustration shows a useful attachment made to fit one of Starrett's internal gages. It is very handy for taking sizes of eccentric straps and thrust bearings, and



AN ATTACHMENT FOR AN INTERNAL GAGE

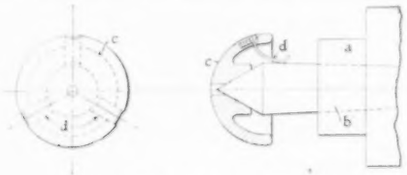
for any work where the inside diameter of the bore is greater at *a* than at *b*. It is made of tool steel, with a split chuck at one end to fit any of the lengthening pieces supplied by the makers with the gage. The other end is hinged as shown, allowing the gage to be inserted and withdrawn from the work.

JAS. WHEELER.

Cap for the Tail-center

Many times when I have been running an engine lathe, and not using the tailstock center (for example on chuck work), I have bumped my arm against the sharp point of that center, causing a nasty cut. This has often happened, even though I had the tailstock drawn back to the extreme end of the bed. Consequently, I made a cap, like the illustration and found that it protected my arm from many digs.

A is the tailstock spindle, *b* is the center, *c* is a cast-iron cap, turned inside to fit on the 60-degree part of the center, and



CAP FOR THE TAIL CENTER

polished on the outside. It is kept in position, centrally, by three fairly strong flat springs *d*. These springs will expand sufficiently to fit two or three sizes of centers. All that is required is to push the cap on the center, and it will remain there.

These caps also protect the centers from being mutilated by mischievous apprentices, who are fond of going round knocking things about. CONRAD.

A Simple Crane Trolley

The crane trolley shown in the sketches is more rigid than many I have seen and will, I believe, run with less friction than others. It is shown in position on the I-beam in Fig. 1, which will serve as an

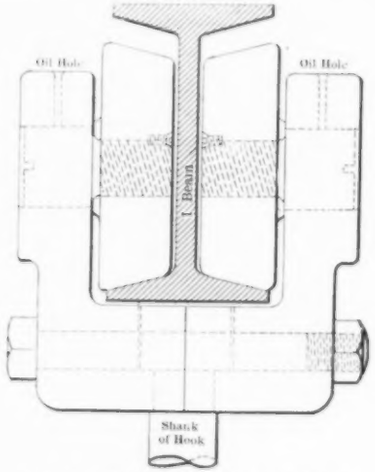


FIG. 1. CRANE TROLLEY ON I-BEAM

assembly drawing of it, as it shows the wheels, the bearings and the frame itself. For those who might wish to build one, I give details in Figs. 2 and 3. These need little explanation, the frame being made in half, as shown in Fig. 2, held together by two 5/8-inch bolts, as detailed in Fig. 3, over the crane hook.

The bearings are formed by the screws which go into the coned wheels, the small screws shown in Fig. 1 preventing these from backing out in use.

CHAS. W. TUCKER.

Taking the Curl out of Celluloid

We had at one time a model of a certain machine, in which it was desirable to show the action of a pin working in the slot of a lever. It was also decided to cut the lever away and fasten a small piece of transparent celluloid (which had been previously cut to conform with the shape of the lever and the slot) across the clearance space—the object being to allow the movements of the parts underneath to be seen. But when it came to fastening the celluloid to the lever, there was trouble; for it had been cut from a roll, and no amount of persuasion would cause it to flatten. The difficulty was finally surmounted in the following manner: Two pieces of cast iron with fairly smooth faces were immersed in boiling water until they had become quite hot. The celluloid was placed between two sheets of wet blotting paper and the whole inserted between the two cast-iron blocks and clamped in an ordinary letter press and left to stand over night. In the morning the piece was as flat as the proverbial pancake, and the job of gluing it to the lever, which had been impossible before on account of the curl, was now accomplished without difficulty.

FORDYCE W. BROWN.

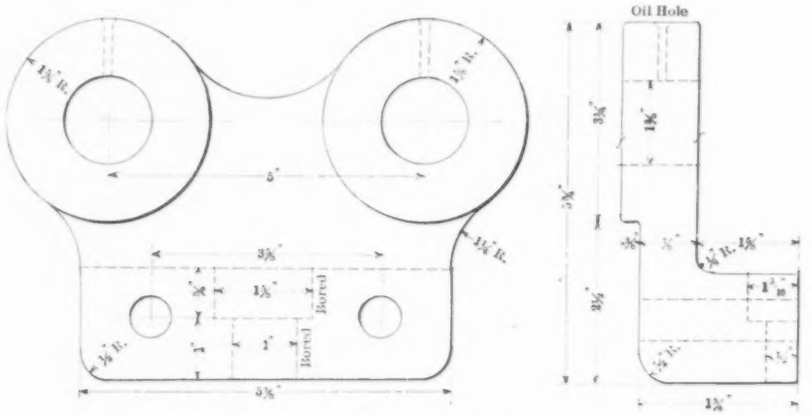


FIG. 2. SIDE AND END VIEW OF FRAME

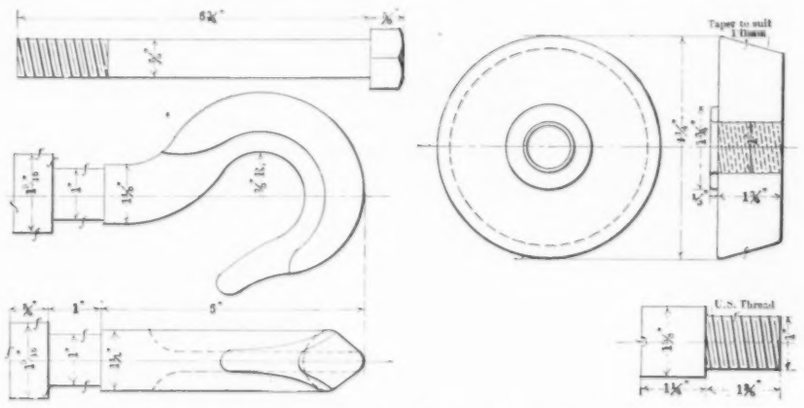


FIG. 3. HOOK AND WHEEL DETAILS OF CRANE TROLLEY

Descriptive Dimensions On Drawings

Noting the communication of Mr. Gay at page 188 in reference to this subject, I am led to add a word. It is my practice in figuring dimensions of tool drawings, to give the figures in such a way as to indicate the accuracy desired. Ordinary dimensions, where no great accuracy is required, are given in vulgar fractions, indicating scale measurement, as 2½ inches for instance, while 2.500 inches would indicate close measurement and 2.500 ± .002 would indicate the plus or minus limit in cases where limits are considered desirable. In jig work it is my custom to figure the bushing sizes .001 larger than the drill or reamer used, giving the center distances of the bushings with such plus or minus limits as may seem desirable. It is my custom to give a complete assembled drawing with all dimensions required for the several parts, and unless the jig or fixture is quite complicated, I do no detailing, other than take off a paper tracing of the cast-iron parts for the use of the patternmaker, giving all pattern figures in full, which are omitted in the as-

sembled view. This saves the pattern-maker considerable time and trouble in getting out the necessary patterns as well as reducing the liability of mistakes. It also allows the toolmakers an opportunity to get out the steel parts while the patterns are being made.

I have had very little trouble when working from assembled views giving all dimensions, even when several toolmakers are working from the same drawing. As there is usually but one jig or fixture required from tool drawings, in most cases and unless the drawing is quite complicated, I do not consider the advantage of detailed drawings of the several separate parts of sufficient importance to justify the expense of making them.

H. D. PENNEY.

The Specialist versus the All-round Man

I didn't intend to go into this discussion till I saw Texas' article at page 88. He is right; the specialist is of little use in the jobbing shop, and the self-dubbed all-round men are, very few of them, worthy of the title.

I had started a new man. He said he preferred lathe work, but had had a lot of all-round experience, including bench work. There was a lever paper-cutter in for repairs. The lever was fastened to the shaft by a taper pin, which went through the lever hub and the shaft. The taper pin had been loose in both and had chewed the hole considerably. The only taper reamer I had that would do was a Morse No. 2. The flutes were about ½ inch longer than the diameter of the lever hub. I gave the man the reamer and a suitable drill and told him to ream the hole and then turn a pin of tool steel to fit. Two hours later he came to me.

"Mr. Dixie, the shank of that reamer is too short."

"Impossible! You don't need any length of shank on that job," said I, as I went with him to find out what was the trouble.

He had run the drill through all right, but had attempted to put the taper reamer through, shank and all, and had only been prevented from doing so by the shortness of the shank.

This man was about 35 years old, and told me he had been 20 years at the business. Subsequently he *did* make good on the lathe.

This reminds me of an experience I had myself. It is a sort of warning to proprietors not to interfere with their foremen in the hiring or discharging of men. If a man is fit to be a foreman at all he should be fit to hire or discharge men. I have never interfered with my foremen in this respect. They have to be responsible for results; and as the men are an important link in the chain of results the foremen should have a perfectly free hand to hire or discharge. Of course, I have had men ask *me* for a job, but I have invariably put the actual hiring of the men up to the foreman.

But to get back to my yarn: I was out of a job and a friend gave me a letter of introduction to the proprietor of a large shop building a number of special machines, no two of which were ever built exactly alike. I saw the proprietor who told me to start in the morning, and gave me a note to the foreman. Although the foreman was in the same building he was neither consulted nor notified that a new man had been hired. Next morning I presented myself at the shop, and before I could say anything the foreman told me that no help was wanted. I handed him the note. I could see it didn't please him, but he said, "All right; what can you do?"

I replied that I could handle almost anything in the way of machine tools, and could do a fair job at the bench or at erecting. He tossed his head and snorted, and I thought, "Dixie, old man, this is where you get quite a run for your money."

"Spice of life?" Well, if I didn't get variety in that shop no one ever did. The shop was a five-story affair, and the foreman jumped me from the little index milling machine under the roof, through every floor, from machine to machine, till I reached the 60-inch planer and six-foot radial on top of the drain pipes in the basement. I managed to hold my end up till a better job was offered me.

Years after this foreman told me that when I sprung that note on him he decided to find a job I couldn't do, and fire me on the strength of it. If he had been a little less reticent and I had been the same, and he had confided in me that he wanted a real good excuse for discharging me, I could have told him quite a number of jobs that Dixie couldn't do.

One thing in favor of the all-round man is this: It is easier to make a specialist of him than it is to make an all-round man of a specialist. Specializing as a general thing seems to narrow a man. All-round work broadens a man, knocks the sharp corners off, the same as traveling does. The specialist is apt to think that the sun rises and sets in, and the universe revolves around, his little measly job. The all-round man knows the operations that have preceded the one he is doing on the work, and can make allowances both for the men who did the work and the condition of the work itself.

In manufacturing, specialists are necessary, but I would if I had any choice, prefer reconstructed, all-round men as my specialists, or, as a second choice, specialists who had worked in many shops in various parts of the country or the world. Of course, all-round men have their specialties. You will generally find a man best at what he likes best. Running a lathe on a certain class of work is not work to me. I like it, and as Mark Twain says: "What a man likes to do is play, whether he gets paid for it or not."

I take exception to the quotation "Jack of all trades," as applying to the all-round man. A jack, or knave, was, at the time when the saying was coined, nearly equivalent to helper; in other words, a handy man. To my thinking an all-round man should be a master, not of all trades, but of many branches of the same trade.

In Scotland the all-round men are millwrights. These men can make a fair drawing, make the patterns, mold them, forge the wrought parts, do the machine and hand work, and erect and run the completed machine. There are few of these men now, as even the Scotch have got down nearer to specializing. It is generally understood that an engineer in Scotland is a "fitter," i.e., a hand worker, vise or floor hand, or erector. He generally serves his full five or seven years' apprenticeship at chipping, filing, scraping and erecting—all hand work. The turner is not generally recognized as an *engineer*. Strange to say, planer hands are often recruited from the ranks of the laborers and handy men. Why, I don't understand; because a planer is not an easy tool to handle efficiently.

In the shop where I served my apprenticeship, in Glasgow, they had a planer that would take 10 feet between housings. This large machine was run by a handy man. As steel, cast-iron, and large brass castings were often planed on this machine, it was fitted with a cone counter-shaft so that different cutting speeds could be obtained. The managing partner of the concern was an old turner who had learned his trade along with a number of the men who worked for him in later years. With these men he would always stop and talk on his way through the shop, when he was not busy. The story goes that the company had decided to retrench, and Mr. Jack, the managing partner, decided to break the news of the cut in wages to his old chums. Stopping at the big planer he said: "Weel, Bruce, we'll hae to cut expenses; instead o' sax pence ha'p'ny an hoor ye'll get sax pence."

Old Bruce looked at him and replied: "A'recht, Maister Jack," reached for the belt pole and threw the belt on the cone to the next slower speed.

"Whit for are ye daein that?" inquired Jack.

"That's the sax-penny speed, Maister Jack," replied old Bruce.

"Weel, pit her back on th' ither speed; we'll no reduce *your* pay," said Jack, as he walked away.

Drillers are generally promoted handy men. The polished parts of engines, such as connecting-rod straps, links, parallel motions for beam engines and similar work, are done by so called engine finishers.

DIXIE.

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Suggestions Wanted

For years the AMERICAN MACHINIST has urged the use of the suggestion box, but it has not taken its own advice. Uncle Sam's and other post-office departments have established a wonderful system of suggestion boxes all over the civilized world, the fee for their use being one or two cents.

We wish our readers would make free use of these suggestion boxes and through them send us suggestions regarding subjects which they would like to see treated in our columns. Such suggestions as meet the approval of the editors will be followed up by them, and the articles, if obtainable, will be published.

For every suggestion which results in an acceptable article we will pay cash. In the nature of the case, some time will be consumed in finding the articles, and this will involve a corresponding delay in sending the checks.

But the thanks will go by return mail.

Hereafter, if you fail to find what you want in the AMERICAN MACHINIST, blame no one but yourself.

Address (postal card preferred) Editor, AMERICAN MACHINIST, 505 Pearl street, New York City.

The Haight Fly-wheel Joint

We hope that no reader of the AMERICAN MACHINIST will fail to read the first article of this issue, as it records a much needed improvement, albeit one which is so simple as to lead one to ask why the construction shown should not have become the common one, long ago.

Few people are aware of the frequency of fly-wheel explosions. For many years the boiler-insurance companies have been educating the public to understand the dangers attending the use of the steam boiler, but fly-wheel insurance is, comparatively, a new thing, and the fly-wheel insurance companies have only begun to do what the boiler-insurance companies have been doing for many years.

The first fly-wheel insurance business organized was, we believe, that of the Fidelity and Casualty Company, of this city, and at the opening of this business it became necessary to study the extent of the risk involved, in order to lay out a scale of premium charges. One method of attacking this problem was to collect statistics regarding the frequency of fly-wheel and of boiler explosions, and to compare the two. This study was made by W. H. Boehm, superintendent of the fly-wheel insurance department, and he informs us that he found an aggregate of about three-quarters as many explosions of fly-wheels as of boilers. Against this, however, was placed the fact that there are more boilers than fly-wheels in use, partly because boilers are more often arranged in batteries than engines are arranged in groups, and partly because boilers are used for heating, drying, and other purposes which do not involve engines. The final conclusion was that the risk of explosion on the part of any one fly-wheel is about 33 per cent. in excess of the risk of explosion by any one boiler—a statement which, we doubt not, will surprise most of those who read it.

In making these comparisons, the ruptures to which boilers are subject, and which do not lead to disastrous results, were ignored, as failures of this class do not occur among fly-wheels, which, when they let go, make a job of it. So far as possible the comparison was limited to that between absolute explosions of boilers and wheels.

With such figures before us it is not necessary to enlarge upon the importance of a radical improvement in fly-wheel construction, and such an improvement is presented in Mr. Haight's joint, whereby, if reasoning counts for anything, a wheel made in parts may have the same strength as a wheel cast in a single piece. Considering the character of the joints in common use, it is not too much to say that Mr. Haight's joint will, on the average, at least double the strength of built-up wheels of the prevailing types. Add to this the fact that the joint involves little or no increase of expense in construction, and it will be seen that Mr. Haight has made an important contribution to mechanical construction, and one which deserves to be immediately and extensively copied.

French Industrial Art Education

The active discussion which is now going on regarding industrial education in this country lends special interest to a report from Paris by Consul-General Frank H. Mason, whose extremely intelligent reports on German industrial education some time ago received due attention in these columns. Mr. Mason's report (which appeared in a recent issue of *Daily Consular and Trade Reports*) deals with an entirely different class of schools from those to which so much attention is being devoted here, namely schools for the artist workman, "where the artisans who are to continue the high traditions of artistic manufacture are educated and prepared for their work."

Of the schools mentioned (all of which are located in Paris) the Germain Pilon School is devoted to the design of furniture and decorations. Its course of study extends through three years and its graduates are said to be always in demand and their promotion to be certain and rapid.

The Bernard Palissy school is devoted to the design and decoration of porcelain, the design of textile fabrics and to carving and sculpture in wood, metal and stone. The course is of four years' duration and the school has 132 pupils. From it come

decorative painters, textile designers and artisan sculptors.

The Estienne school teaches the arts connected with the production of books, artistic typography, binding, engraving on wood, metal and stone, photography, lithography and photogravure. The course extends through four years with an extension of a year for students in lithography or photogravure. The school has about 200 pupils and graduates from 50 to 60 per annum.

The Diderut school teaches the higher grades of work in wood and metal—the manufacture of instruments of precision, artistic forging, electrical fittings, etc. The course here covers three years and the school has 326 pupils.

Other schools are the Alembert School, devoted to painting and furniture making, the evening schools of the Polytechnic Association and several schools for girls where they are taught "all the vast range of delicate, dainty handiwork for women in the production of which Paris is unrivaled."

Mr. Mason concludes his report thus: "Such, in brief, is the system of industrial art education which has done and is doing so much to render French taste and workmanship the standards for other nations, and to build up and sustain a vast export trade in merchandise in which originality of design and the intelligent handicraft of the educated artisan form the principal elements of value.

"May it not be reasonably hoped that, with the ripening of our civilization, such intelligent and liberal purpose may be shown in respect to industrial art education that future generations of Americans may not only buy at home many of the costliest goods that they now import, but compete as exporters of the choicest manufactures in which Europe, and especially France, has now a virtual monopoly?"

According to a statement by an official of the Pennsylvania Railroad, cars will soon be run by electricity over the Pennsylvania Railroad between Philadelphia and Pittsburg, Penn. According to this statement, work will soon be started on a power plant and dam at Iroquois, about twenty miles west of Harrisburg, to furnish power to supply the telegraph and signal towers and to run cars between Aqueduct and Mifflin. Hundreds of acres of land have been purchased by the railroad at Iroquois, much of it along the river front.—*Electrical Review.*

A gear for foot-propelled bicycles which gives four speeds, will, to the old-time rider, appear as a surprising novelty. Such a device was shown on a Pernot cycle at the Paris salon. Only one chain is used; it runs over a front sprocket wheel of variable diameter. The slack in the chain is taken care of by spring-controlled idlers.

NEW TOOLS AND MACHINE SHOP APPLIANCES

A NEW LINE OF ELECTRIC CONTROLLERS FOR CRANES

The accompanying illustrations show two of a new line of controllers which were built to meet the requirements of general crane service, where the conditions are not severe enough to demand the use of the Dinkey ventilated controller. Types G-3 and G-4 controllers are built with coil resistance, and the types G-5 and G-6 with cast-grid resistance. The

FIG. 1. FRONT VIEW OF G-5 CONTROLLER WITH CASE REMOVED

FIG. 2. REAR VIEW OF G-6 CONTROLLER WITH CASE REMOVED

type G-5 is shown in Fig. 1 and the type G-6 in Fig. 2. When it is desired to place controllers above or in the rear of the operator, the type G controller is furnished, arranged for under lever operation. They are also furnished with spring return for operation from the floor by means of pendant ropes or chains. A number of crane users have decided that a 15- or 20-ton crane, requiring a 25- or 30-horse-power motor on the hoist and bridge motion, may be operated from the floor by any of the men in the shop, thus saving the wages of a crane operator who would probably be idle half his time. Cutouts may readily be placed at the ends of the trolley travel and of the runway to prevent accident. The type G controller meets this demand for a controller up to 50-horse-power, arranged for operation from the floor by means of ropes. This controller is a self-contained unit, the resistance being placed in the frame, making it necessary to run only four wires between the controller and motor. Reversal is accomplished by the use of a single lever, no separate reverse switch being required. All parts are made to jig and are interchangeable. On a contact face of heavy slate are mounted the copper contact segments, which are screwed to brass lugs to which all wiring connections are mad By this construction any of the contact segments can be removed and replaced without disturbing the wiring connections. The contact fingers may be removed and replaced without removing the contact arm. An effective blow-out is provided in all sizes of these controllers.

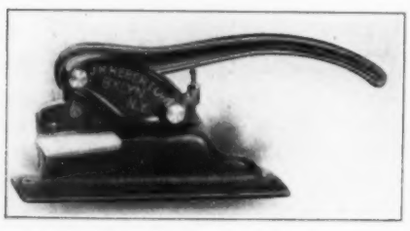
The frame for type G-3 and G-5 controllers consists of a main casting in one

piece provided with a cover, the removal of which affords easy access to all resistance connections. The case inclosing this frame is of perforated steel, thus allowing ample ventilation. The frame of the G-4 and G-6 controllers consists of a bottom casting which supports the resistance, and a top casting which supports the contact slate and arm. The top and bottom castings are connected by means of four steel corner-posts, around which a casing of perforated steel is provided for ventilation and protection to resistance. The top casting of the G-4 and G-6 controllers supports the contact slate which is completely covered and protected by a sheet-steel casing. This protects the operator from coming in contact with any live parts of the controller, and also protects the working parts of the controller from dust and dirt. Easy operation is secured by a lever which is keyed to the arm shaft at the back of the top casting, which gives a short movement of about 10 inches in either direction for both starting and reversing.

The resistance for the G-5 controller is built of cast grids in a single bank which may easily be removed as a unit without disturbing the other parts or moving the controller. The resistance for the G-6 controller is made of two banks supported on bars attached to the frame, and may be removed in separate units without disturbing the other parts. The resistance for type G-3 and G-4 controllers is made up of type E coils which consist of a heavy asbestos tube stiffened by means of a central brass tube which serves to bring the rear terminal forward, facilitating the necessary connections. These controllers, termed their "type G" by the manufacturers, the Electric Controller and Supply Company, of Cleveland, O., are rated from 1 to 50 horse-power, and are adaptable for service up to 500 volts. Six points of control are provided with the G-3 and G-5 controllers and eight points of control with the G-4 and G-6 controllers.

A BENCH SHEAR

This tool is designed for the use of sheet-metal workers and will cut sheet iron of any width or length up to ⅛ inch



A BENCH SHEAR

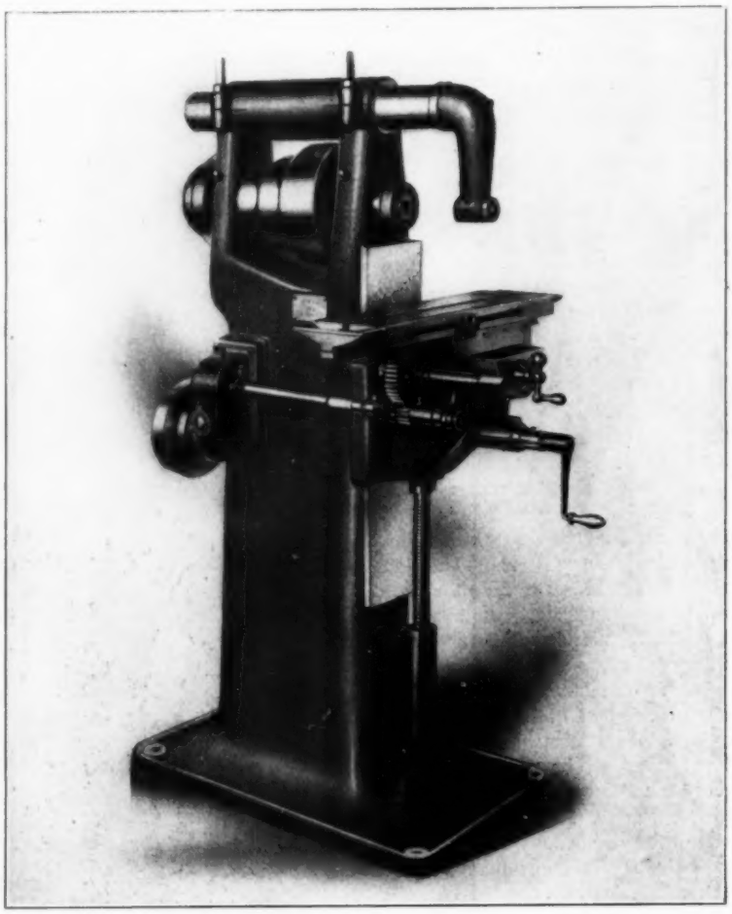
thick, and steel, brass, copper and other metals in proportion.

The shear is actuated by a cam face on the lever which bears on an anti-friction roller between it and the shear. The shear is lifted by a link connecting it with the lever. The screw under the lever is to adjust the stroke of the shear blade, to prevent buckling the work when cutting long strips. The jaws are milled. All parts are drilled in jigs and are interchangeable. The shear blades are ground on a surface grinder on all sides and fit either the upper or the lower jaw. The upper jaw is a steel casting. The shelf is removable.

These bench shears are made by the J. R. Hebert Company, 256 St. James Place, Brooklyn, N. Y.

PLAIN MILLING MACHINE

The milling machine shown herewith is designed for general light manufacturing, being suitable for manufacturers of electrical goods, brass workers, sewing machine manufacturers, etc. The spindle has a No. 9 Brown & Sharpe taper. The table has a working surface 25x6⅛ inches; it has an automatic feed of 18 inches, and a quick return by means of crank, rack and pinion, a little more than 1½ turns of the crank moving the table the entire length. The adjustment in line with the spindle is 4½ inches. The knee is of the box type and has a vertical adjustment of 13 inches. The machine will swing 10 inches under the arm; the vise has a capacity of 3½x1⅛x2 inches. The feed is by means of rack and pinion driven by worm gearing inclosed in gear boxes, the feed belt running at a very high speed and the gearing ratio being 361 to 1, giving a very powerful feed. The feeds are 0.004, 0.008, and 0.012 inch per revolution. The dials are adjustable and graduated to read to thousandths of an inch. The countershaft speed is 125 revolutions per minute; the net weight of the machine, 1100 pounds. It is made by Wainwright & Kelly, Trenton, N. J., and is designated by them as their No. 1.



PLAIN MILLING MACHINE

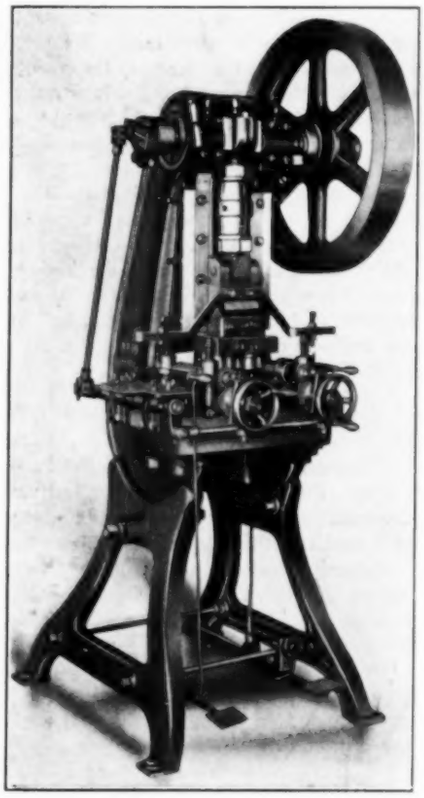
AUTOMATIC PRESS FOR MAKING ROOF BUTTONS

For a number of years, roof buttons have been made from the scrap material which accumulates very rapidly in pieced tinware and tin-can factories. But with the large and increasing demand for roof buttons, it has been found that the number that could be made from scrap metal was not sufficient to meet the requirements. It therefore became necessary to make the buttons from tin strips prepared for the purpose. The price paid for the button being so low and the expense for the tin plate being considerably more than for the scrap, it was essential that the buttons be

produced with the smallest possible operating expense. To do this the machine illustrated was designed and built.

The press proper is a standard machine, but, to facilitate handling, it is fitted with a special roll feed and with the rolls extra close together so as to admit of handling short strips of tin. The first set of rolls is used for feeding the material and the second for keeping a proper tension on the stock and for carrying away the scrap. The press is provided with a device for releasing the rolls by hand or foot as desired, for convenience in starting a new strip.

As shown, the machine is fitted with six dies, three forming and center-hole punching dies and three cutting dies, which pro-



AUTOMATIC PRESS FOR MAKING ROOF BUTTONS

duce three complete 1⅛-inch caps at each stroke of the press; and inasmuch as the machine can be readily run at 80 strokes per minute, one press will produce 240 caps per minute or 140,000 per day of 10 hours by continuous running. Considering the fact that the machine can be attended to by inexperienced help, it will be readily seen that a very large number of caps can be made at a small expense.

The total weight of the machine as shown is 1300 pounds. It is possible, however, to use the same style of feeding mechanism on a larger press.

This machine was designed and built by the E. W. Bliss Company, 1 Adams street, Brooklyn, N. Y.

German-silver Knife Tips

Everyone is familiar with the ordinary pocket-knife and has seen the tips on them made of german silver. It may be a surprise to many to know that many of these tips are made of german-silver castings. This line of trade probably constitutes the smallest size casting that enters the brass foundry. As far as known, there is now only one foundry in the United States that produces the tips.

The advantage of the cast german-silver tip over one made from sheet german silver is that it is ready for use and requires no blanking or stamping to form it. In the use of sheet german silver, the tips must first be blanked out. This necessitates the production of 40 or 50 per cent. of scrap. After the tips have been blanked they must be formed under a drop, with successive annealings, until they are formed into the oval shape ready for use. The cast german silver, however, only requires polishing and is ready for use.

The tips are cast with a large number on a gate, and with two gates in a flask. They are poured "on end." Scrap german silver is used and about two ounces of aluminum reduces the oxide in the german silver, and it then runs very freely. The color is also much improved and soundness is imparted to it.

The manufacture of these german-silver knife tips forms an unique industry. They are so small that one would scarcely believe that it pays to make them in this manner. In the smallest sizes, several hundred pieces make a pound. The price obtained for them is from 50 cents to $1 a pound. The foundry which is making them claims that it pays.—*The Brass World.*

Paper from Cotton Stalks

The manufacture of paper from the fiber of the cotton stalk has passed the experimental stage according to a report of the United States Department of Labor and Commerce. It is asserted that all grades of paper from the best form of linen to the lowest grade can be manufactured from cotton stalks. In addition to this, a variety of by-products, such as alcohol, nitrogen material for gun-cotton, and smokeless powder can also be secured in paying quantities. It is estimated that on an area of land producing a bale of cotton at least one ton of stalk can be gathered. Upon this basis from ten to twelve million tons of raw material could be secured for the production of paper, which would increase the value of the Southern States cotton crop nearly two millions sterling. A company has been organized under the laws of Maine, with a capital of three million pounds for the purpose of manufacturing pulp and paper from cotton stalks. —*The Indian Electrical Mechanical and Textile News.*

The International Exposition of Safety Devices and Industrial Hygiene

This exhibition, the first of its kind in this country, was opened at the American Museum of Natural History, Seventy-seventh street and Central Park West, New York, January 29, and closed Feb-

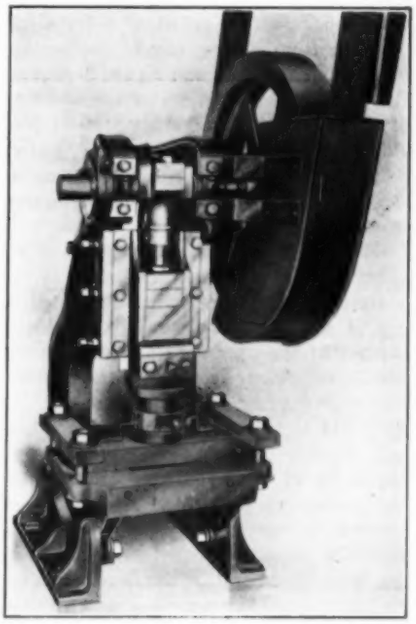


FIG. 1. PUNCH PRESS FOR MICA WITH MICA SAFETY GUARD

ruary 12. It was under the auspices of the American Institute of Social Service, New York.

The very worthy object of this exposition was to direct the attention of the American public to the necessity of doing something to lessen the causes of accident

FIG. 2. THE DIE AND BOLSTER

to American life, limb, and health, by means of a permanent museum of safety devices where all problems of safeguarding life, limb, and health can be studied in their working details.

The exhibition was under the direction of Dr. William H. Tolman, although he asserted that Mrs. Tolman's energy was

responsible for the excellent showing which was made. The exhibits were many and diverse, ranging from safety corundum wheels to safety cuspidors. Many of the devices were old, as not novelty but efficiency was the password by which they gained admission.

The General Electric Company, Schenectady, N. Y., had a motor-driven Flather shaper with safety guards, a Garvin miller, also motor-driven, and a punch press with a mica safety guard to prevent the operator from getting caught in the die. Figs. 1 and 2 give a good idea of the device for protecting the fingers of the operator of a mica punch press. This press is provided with a transparent ring guard, which prevents catching the fingers under the punch, at the same time permitting inspection of the work.

One of the most frequent causes of accident in the wood-working shop is the surface planer. The device illustrated in Fig. 3 removes the chance of accidental contact of the operator's fingers with the revolving cutter. It consists of thin steel bands completely covering the cutter. As the work is fed toward the cutters a certain number of the bands, depending on the width of the piece, are pushed below the surface of the table. The width of the cutter not actually removing stock, however, remains covered by the protecting steel bands, so that the fingers guiding the piece cannot come in contact with the cutter blades. The guarding bands, being worked against a spring, return to position as they are uncovered.

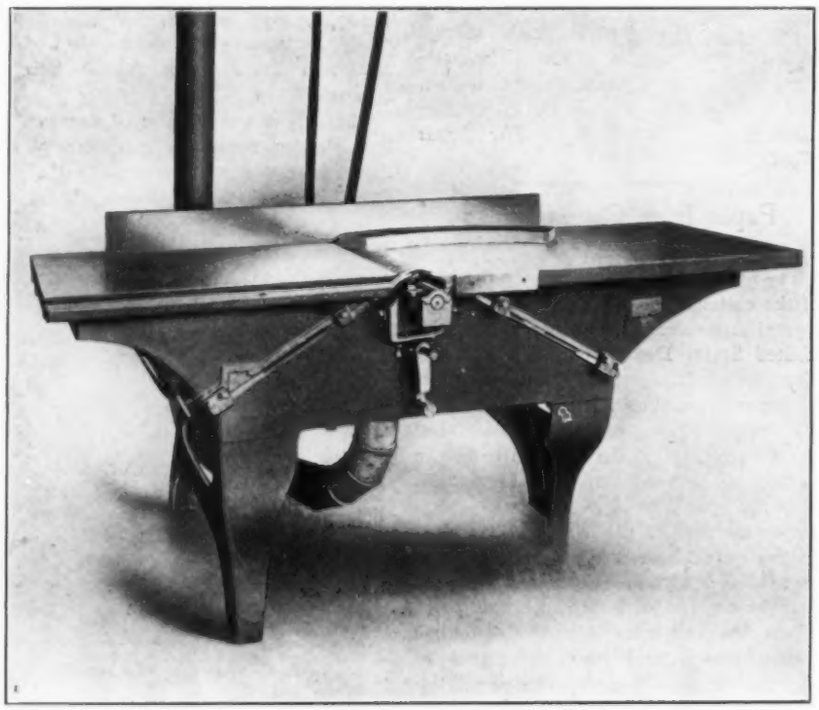


FIG. 3. SURFACE PLANER WITH SAFETY GUARD

The gentleman in charge of this exhibit found himself without a motor to drive the punch press. However, he is resourceful, and a pulley on the arbor of the milling machine served as a drive for it. As it would necessitate constant attention to stand and trip the press every revolution he again brought his resourcefulness into play and ran the pulley backward, thus making it run continuously without attention or fastening the trip down. The funny thing about this is that 90 per cent. of the people who stopped and admired that punch press imagined that a milling machine was always used as a countershaft for a punch press.

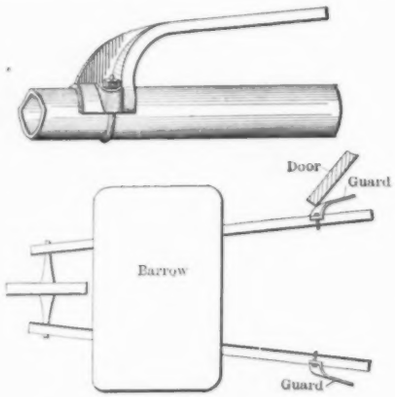
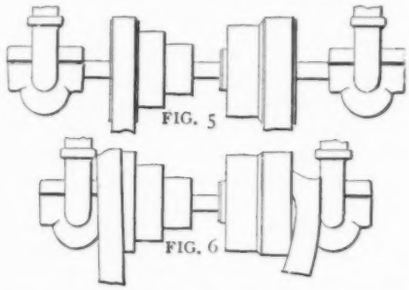


FIG. 4. A KNUCKLE GUARD FOR A WHEELBARROW

To my mind the neatest little thing in the whole show was a wheelbarrow-handle-knuckle-safety-guard made by Brown & Sharpe for use in their works, to protect the knuckles of those who push barrows from being barked by doors when passing through doorways. It is shown in Fig. 4.

Figs. 5 and 6, reproduced from a blueprint by Brown & Sharpe, show the right and the wrong way to space pulleys on countershafts. Fig. 5 shows the right way; the countershaft has spaces allowed so that if the belts slip off they cannot



RIGHT AND WRONG WAY TO SPACE PULLEYS ON SHAFTS

wedge and pull the countershaft down on to the workman. Fig. 6 shows the wrong way, insufficient space being left for the belts should they slip off. This will endanger the workman as the countershaft may be pulled down.

The object of the exhibition is a worthy one and it should have received greater support than it did. However, this is the first attempt, and the knowledge of how to attract is a matter of experience, and experience is only gained in one way—by experience. E. A. S.

New Publications

"Engineering Series of the Colorado College Publication." Vol. 1, No. 1-2. Containing The Fusibility and Fluidity of Titaniferous Silicates and Design of a Low-tension Switchboard. 34 pages, 6x9⅛ inches. Published by the School of Engineering of Colorado College, Colorado Springs, Colo.

This is the commencement of a series intended to publish the results of research work carried on by the faculty and engineering students.

"Annuaire pour l'An 1907, Publié par le Bureau des Longitudes." 682 pages + 219 pages of appendices, 3¾x6 inches. Gauthier-Villars, Imprimeur-Libraire du Bureau des Longitudes, Paris. Price, in France, 1 fr. 85.

This almanac is full of data for the man of science, especially if he be interested in astronomy, meteorology, geography, etc. It contains a quite full compend of the monetary systems of different countries, besides weights, measures, statistics, etc.

"The Treatment of Storage Batteries." By R. W. Vicarey. 58 pages, 8½x10⅞ inches, with illustrations. The Electric Accumulator, London. Price, 2s. 6d.

This is an excellent practical guide for those who use and take care of electric storage batteries. It contains neither the history of the storage battery, descriptions of various kinds of cells, processes

of manufacture, deep theory, nor mathematics; but is full of useful instructions written by a man of many years' experience with this class of apparatus, in language easily understood. It contains a glossary of terms, many of them being very elementary.

Personal

E. A. Pettit has just accepted a position with the Illinois Steel Company as draftsman.

George E. Maynard has taken a position as draftsman with the Indiana Steel Company.

J. B. Seaverns has taken a position with the Jeffrey Manufacturing Company as mechanical draftsman.

Hugo Benzing, mechanical engineer, has taken a position with the Crandall Typewriter Company, as experimental engineer.

Otis Herreman has taken a position as mechanical draftsman at the North Chicago plant of the American Steel and Wire Company.

C. W. Tucker has taken a position with the Hunt Engineering Company, at South Pittsburg, Tenn., as a mechanical draftsman, power plant layout.

Oscar Larson, recently with Plano Division International Harvester Company, as mechanical draftsman, has accepted a position with Whiting Foundry and Equipment Company.

C. W. Woodard, recently with the Link Belt Company, in its machine shop and drafting room, has taken a position with Adams-Westlake Company, in the superintendent's office.

H. F. Tucker has recently accepted a position with the Isthmian Canal Commission, taking up work where he will be assisting in the design of locks and regulating mechanism for the canal.

J. C. Linder, for many years connected with the Abrasive Material Company of Philadelphia, Penn., has been appointed superintendent of the Vitrified Wheel Department of the Star Corundum Wheel Company, Ltd., of Detroit, Mich.

J. H. Dalton, who for the last twenty odd years has been connected with power plants in and around Chicago, has taken a position as chief engineer with the American Color-Type Company. He will have entire charge of the power plant and electrical equipment.

L. Lambert, for twenty-six years connected with the Brown & Sharpe Manufacturing Company, Providence, R. I., has resigned his position with that concern and accepted a place as general superintendent of the Victor Talking Machine Company, Camden, N. J.

The Philadelphia Supply and Machinery Dealers' Association celebrated its first anniversary February 15, by a dinner at the Bellevue-Stratford hotel. The retiring president, Mr. Spaulding, of Spaulding & Metcalf, is succeeded by Mr. Maddoch, of Maddoch & Co. In addition to the members of the association a number of guests were present. W. E. Shipley, Bourse, Philadelphia, is secretary.

The Hyatt Roller Bearing Company, Harrison, N. J., has distributed to its guests at the Fifth Frictionless Feast, held January 16 last, a unique souvenir program and menu and with it an equally unique scarf pin.

Manufacturers

The city of Ashland, Wis., voted to install a municipal lighting plant.

The Atlantic Refining Company, Harrisburg, Penn., will erect an addition to its plant.

The F. A. Whitney Carriage Company, Leominster, Mass., will erect a new factory.

The Waterous Engine Works, Brantford, Ont., will build an extension to the main shop.

The Holscher Electrical Manufacturing Company, Warren, Ohio, will erect a new factory.

Finnessey & Kobler, wagon builders, Philadelphia, Penn., will erect a new $30,000 factory.

The Grand Rapids (Mich.) Hand Screw Company is erecting a new plant to cost $50,000.

A. G. Schultz & Co., Baltimore, Md., silverware manufacturers, will build a new four-story factory.

The Bristol (Conn.) Manufacturing Company will erect a modern power plant to replace the present one.

The Baker Gun Works, Batavia, N. Y., will enlarge its plant. A drop-forging department will be installed.

The Dennison Manufacturing Company will erect a new power plant at its facory in South Framingham, Mass.

Plans have been made for an addition to the tube mill of the Coe Brass Manufacturing Company, Torrington, Conn.

The American Machine Typesetting Company, Stamford, Conn., has commenced the erection of its new factory.

The Standard Bolt and Nut Company, Pawtucket, R. I., has awarded contract for the construction of a new plant.

The Miller Lock Company, Philadelphia, Penn., is having plans prepared for a new factory to be erected in Tacony.

Work will soon begin on the new shops of the Seaboard Air Line Railroad at Columbia, S. C. These will cost about $250,000.

The Lisk Manufacturing Company, Canandaigua, N. Y., makers of enameled and galvanized iron ware, etc., will put up a new plant.

The plant of the South Atlantic Car Works at Savannah, Ga., was destroyed by fire, causing a loss of $300,000. It will probably be rebuilt.

The Edison Electric Illuminating Company, 360 Pearl street, Brooklyn, N. Y., would like to receive catalogs for its purchasing department files.

The Doak Gas Engine Company, formerly of San Francisco, has purchased property in Sacramento, which it will enlarge and remodel for its needs.

The Birmingham (Ala.) Railway, Light and Power Company will probably soon begin the erction of the new power plant to cost about $1,500,000.

The Pasadena (Cal.) Ice and Cold Storage Company has had plans prepared for the enlargement of its plant. New machinery and boilers will be installed.

The Western Ice and Cold Storage Company has been incorporated at Oakland, Cal. Capital $100,000. Thos. C. Spilker, A. A. Enke, etc., incorporators.

The Midland Condenser Company, Buffalo, N. Y., a new concern, has had plans prepared for its factory buildings, which will include an electrical power plant.

The Goodwin Brothers & Company has been incorporated at Dover, Del., and will erect a packing plant. The company will also make its own boxes and crates.

The Delaware & Hudson Railway Company, with offices at 32 Nassau street, New York, has purchased land at St. Lambert, Canada, for the purpose of erecting repair shops.

The Connecticut Computing Company, New Haven, Conn., which was incorporated a short time ago, with a capital of $600,000, is having plans drawn for a factory building.

The Nonquitt Spinning Company has been incorporated with a capital of $1,200,000 and will erect a large mill at New Bedford, Mass. William F. Draper, of Hopedale, Mass., is one of the incorporators.

The Rapid Railway Company, with general offices in Detroit, Mich., it is said, will spend $80,000 in Port Huron in the erection of a new power house and equipping it with six large converters.

The William E. Gang Company, of 1543-47 Queen City avenue, Cincinnati, O., is making extensions and improvements to its factory which will give it about 3500 square feet additional floor space.

Wm. B. Shaw and J. H. Sticker, Sacramento, Cal., have incorporated as the Phœnix Boiler and Iron Works, and will put up a plant for the manufacture of tanks, structural iron work and smokestacks.

The Pennsylvania Railroad Company will erect a power plant and dam at Iroquois, Penn. It is also reported that the company will build at Harrison, Penn. a plant for the manufacture of cars and electric engines.

The Mueller Machine Tool Company, of Cincinnati, O., has recently been incorporated and will erect a new and up-to-date shop on Colerain avenue, near Draper street. This it expects to have completed by next spring.

The Winona Portland Cement Company, capitalized at $1,000,000 and composed largely of Selma, Ala., capital, will erect a plant at Epes, Ala., A. G. Parrish, president of the City National Bank of Selma, is interested.

The International Time Recording Company, of Binghamton, N. Y., has purchased the plant of the Dey Time Register Company of Syracuse, and will move it to Endicott where the former company is erecting a new plant.

The Standard Safe and Lock Company has been incorporated at Des Moines, Iowa, with a capital of $75,000. A plant for the manufacture of safes, locks, etc., will be erected. W. C. Hutton, F. C. Waterbury, and others incorporators.

The Calhoun Falls Company has been organized at Charleston, S. C., with a capital of $280,000. A plant to develop 27,000 horsepower will be built at Calhoun Falls on the Savannah river. Patrick Calhoun is president of the company.

The Brooklyn (N. Y.) Rapid Transit Company will erect a sub-station power-house at Corona, L. I., to cost $35,000, and a new building at Maspeth, which will include machine shop, car barn, etc., for which $500,000 has been allowed.

The Seneca Iron and Steel Company, a new concern composed of Buffalo and Pittsburg capitalists, is erecting a sheet mill,

which will employ 250 men at Buffalo, N. Y. James S. Paterson of Buffalo is said to be at the head of the company.

James B. Rountree and Robert E. Cook, formerly connected with the American Locomotive Works, have organized the American Foundry Company and will establish a plant on Eighth street, Manchester, Va., for the maufacture of iron and brass fixtures.

An appropriation of $50,000 has been granted by the Government for the establishing of machine shops at the Summerville, Ga., arsenal for the repair of coast-defense artillery and heavy ordnance of all kinds, and it is said that $200,000 more will be appropriated later.

Edwin F. Goltra, of St. Louis, Mo., is said to be promoting a project for establishing a large independent car-manufacturing plant in Houston, Texas. B. F. Yoakum, of New York, chairman of the Rock Island and Frisco executive boards, is also reported to be financially interested.

The Virginia Portland Cement Company, Fordwick, Va., will increase the capacity of its plant and make extensive improvements, among which will be a new power-house. All the machinery is to be driven by electricity. Consulting engineers are W. S. Barstow & Co., of New York and Portland, Ore.

Trade Catalogs

Western Electric Co., Chicago, Ill. Pamphlet illustrating and describing the Hawthorne Works of this company.

The R. A. Kelly Co., Xenia, Ohio. Catalog describing crank shapers. Illustrated, 23 pages, 6x9 inches, paper.

Garvin Machine Co., Spring & Varick Streets, New York. Pamphlet illustrating motor driven machine tools.

Charles T. Burlin, Whitinville, Mass. Pamphlet illustrating and describing magnetic metal separator. 3½x5½ inches.

Hermann Boker & Co., 101-102 Duane St., New York. Jan. 1, 1907, price list of Novo high speed twist drills. Illustrated.

Page Engineering Co., 119-121 E. York St., Baltimore, Md. Catalog of the Oriole marine engines. Illustrated, 6x9 inches, paper.

Edwin E. Bartlett, 364 Atlantic Ave., Boston, Mass. Catalog describing the Gregnerd arbor press. Illustrated, 4x9 inches, paper.

The Cleveland Twist Drill Co., Cleveland, Ohio. Catalog No. 34, describing high-speed drills. Illustrated, 24 pages, 6x9 inches, paper.

Baker Bros., Toledo, Ohio. Catalog No. 5-B, describing drilling, boring and tapping machinery. Illustrated, 32 pages, 6x9 inches, paper.

General Electric Co., Schenectady, N. Y. Catalog of electric heating and cooking devices. Illustrated, 24 pages, 8x10½ inches, paper.

Warren Bros. Co., 93 Federal St., Boston, Mass. Catalog describing slushing compound to prevent corrosion and rust. Illustrated 3x6 inches, paper.

B. F. Barnes Co., Rockford, Ill. 1907 catalog of upright drills, gang drills, tool grinders key seaters. Illustrated, 88 pages, 6x9 inches, paper.

F. A. Errington, 39 Cortlandt St., New York. Catalog of automatic-reverse tapping chuck. Illustrated, 16 pages, 3½x6½ inches, paper.

James Coyne, M. E., 121 Haverhill St., Boston, Mass. Catalogs of steam engineering school and trade school for machinists. Illustrated.

"Diamond" Power Specialty Co., Detroit, Mich. Pamphlet entitled "Evolution of a Machine Shop," which describes the Diamond improved turret head and steam flue blower. Illustrated, 15 pages, 3½x6½ inches, paper.

Ingersoll-Rand Co., 11 Broadway, New York. Catalog No. 46, describing Rand rock drills. Illustrated, 84 pages, 6x9 inches, paper. Catalog H36, devoted to Ingersoll-Sergeant class "H" air and gas compressors. Illustrated, 64 pages, 6x9 inches, paper.

New Britain Machine Co., New Britain, Conn. Catalog of shop furniture, including tools, racks, lathe pans, stools, etc. Illustrated, 52 pages, 4x7½ inches, paper. Catalog describing "New Britain" dado machine. Illustrated, 16 pages, 4x7½ inches, paper.

American Locomotive Co., New York. Catalog of ten-wheel type locomotive weighing less than 150,000 pounds. Illustrated, 54 pages, 6x9 inches, paper. Catalog of consolidation type freight locomotives weighing more than 175,000 pounds. Illustrated, 68 pages, 6x9 inches, paper.

Miscellaneous Wants

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cox Computers, 75 Broad St., New York.

Caliper cat. free. E.G.Smith Co., Columbia, Pa.

Universal Test Indicator circulars free. H. A. Lowe, Lock Box 146, Cleveland, O.

Light fine machry. to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Draftsmen furnished; no charge to employers, no fee for registering. Draftsmen's Exchange, Scranton, Pa.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—Upright drills for sale in Great Britain, France and Italy. Will carry large stock. Apply Box 456, AMERICAN MACHINIST.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACHINIST.

Wanted—To correspond with parties who have light, special machinery to build under contract; our shops are large and fully equipped with modern, up-to-date machinery. Address Trump Bros. Machine Co., Wilmington, Del.

Isaac B. Owens, patent attorney, 100 Broadway, New York City, specialist in oil and gas engines, automobiles and automatic machinery. Patent applications entrusted to me will receive careful, personal attention, and patents secured which will protect.

Wanted—The following second-hand machinery which must be in good condition: one compound marine engine, inverted cylinders, 10 and 24 inches diameter, 16 inches stroke approximate; one direct coupled electric generator about 5 kw., one circulating engine cylinder 4 or 5 inches diameter; one surface condenser about 600 square feet cooling surface. Box 623, AMERICAN MACHINIST.

Successful draftsmen drawing $125 to $200 monthly require thorough drafting room knowledge. As chief draftsman of engineering firm I know exactly the quality and quantity of experience and practical training you must have, and prepare you by mail, home instructions for above paying positions, which I furnish free anywhere. Complete highest grade drawing outfit, with German silver set of tools, value $13.85, free. Address Chief Draftsman, Div. 4., Eng.'s Equip't Co., (Inc.), Chicago.

Business Opportunities

We can build machinery for quick delivery. A shop building machine tools wishes to take contracts for the construction of machinery or anything that can be produced in a foundry and machine shop. Send drawings and specifications and estimates will be made with guarantee of quick delivery. We can refer to a standard line of tools now on the market as to the quality of workmanship. Box 75, AMERICAN MACHINIST.

Wanted—A good superintendent capable of handling pattern shop, foundry and machine shop departments in a general jobbing, repairing and manufacturing shop located in a rapidly growing city of two hundred thousand inhabitants, center of a big lumbering country in the West; one who could invest about $10,000 preferred, and excellent opening for the right man. Full investigation demanded and given. Address Box 692, AMERICAN MACHINIST.

Machine shop and foundry for sale. Here is a great opportunity for two or three good men to get into business; this is a complete plant located in one of the best cities in Ohio; equipment includes 30 lathes, 3 planers, many other tools, completely equipped foundry, boiler shop, blacksmith shop and pattern shop; this plant has fine jobbing trade; price low and terms very reasonable; would like to correspond with practical machinists and foundry men who have some money; can give right men opportunity of their lives. William A. Reade & Company, 402 Chamber of Commerce Building, Cleveland, Ohio.

For Sale

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—One second-hand 800-lb. single frame Morgan steam hammer. Box 660, AM.M.

Complete book; 200 pages on gas and oil engines; $1.50. W. Beckley, 126 South Ave., Rochester, N. Y.

For Sale—Cyclopedia of modern shop practice, four volumes; bound in green morocco leather. Practically new; cost $18; will sell for $6. Address L. N. O., Box 425, Chicago, Ill.

Milling machine for sale, No. 2 Cincinnati universal milling machine, practically new, motor driven, 220 volt, direct current, General Electric Company's motor. Inquire Dragon Automobile Company, 31st and Chestnut Sts., Philadelphia, Pa.

For Sale—Old established machine shop, building steam engines and ice machines, and having large jobbing repair trade. Plenty of orders ahead. Modern brick buildings, large grounds, and railroad siding. Location, eastern Pennsylvania. Box 697, AMER. MACH.

Wants

Situations and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Position as toolroom or department foreman in Cleveland, O., filling similar position at present, first-class mechanic and capable of handling men to best advantage; age 30, A-1 reasons for changing, references. Address Box 690, AMERICAN MACHINIST.

ILLINOIS

Draftsman — Engineer in charge of large drafting room in the West wants work in the East. Box 546, AMERICAN MACHINIST.

Mechanical draftsman, university graduate; three years' practical shop and drafting room experience is open for a position in factory. "A. K.," Care AMERICAN MACHINIST.

Superintendent—Young man, having ten years' experience in charge; a first-class economical, modern organizer and executive; a practical toolmaker, engineer and inventor; excellent references. Box 672, AM. MACH.

MASSACHUSETTS

General foreman or assistant superintendent for shop producing valves, fittings, and piping for high-pressure power plants; 12 years' shop experience as toolmaker foreman and designer; excellent references. Box 681, AMERICAN MACHINIST.

NEW JERSEY

Mechanical engineer and designing draftsman; wide experience on marine and general heavy machinery, desires to change position. Box 683, AMERICAN MACHINIST.

NEW YORK

Draftsman of experience seeks position. Box 694, AMERICAN MACHINIST.

Mechanical draftsman desires to change; experienced in press, dies and special fixtures. Box 699, AMERICAN MACHINIST.

Draftsman—Experienced machine designers desire engagement, New York or New Jersey preferred. Box 652, AMERICAN MACHINIST.

Engineer, producer gas engine, power and electric plants; large experience in design, manufacture and installation. Box 682, AMERICAN MACHINIST.

Expert in patent drafting and developing desires a few more clients; intricate machinery specialty; A-1 work for A-1 price; secrecy guaranteed. Box 606, AMERICAN MACHINIST.

Machinist, toolmaker; first class; 16 years' experience; would prefer a position as inspector or take charge over some experimental work, or any position of trust. Box 688, AMERICAN MACHINIST.

Position as superintendent of machine shops; accurate, interchangeable commercial work; married man with first-class reference; character and ability open. Address Box 689, AMERICAN MACHINIST.

Experienced superintendent or purchasing agent; desires change; high-grade interchangeable work, methodical increase in production; appliances improved; costs reduced. Box 695, AMERICAN MACHINIST.

Foreman; age 29; strictly first-class machinist, toolmaker, all kinds of work, good in developing inventions, drawings; 15 years' experience; wants position; highest references. Box 677, AMERICAN MACHINIST.

Position as manager of works; held similar position seven years; can improve and design machinery; good mechanical, executive and business abilities; furnish best of references from concern where now employed. Box 374, AMERICAN MACHINIST.

Graduate mechanical engineer, now in charge of engineering department; New York office of large manufacturing concern desires to change as manager or representative here or abroad; good executive; first-class references. State full particulars. Box 676, AM. M.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

A man thoroughly capable of acting as machine shop foreman, working on steam hammer forgings, exclusively. State wages expected, and also how soon could come. Address "X. C.," AMERICAN MACHINIST.

CONNECTICUT

Wanted—First-class operator on Jones & Lamson turret lathe; also one first-class all-around machinist. The New Machine Co., Danbury, Conn.

Wanted—A competent draftsman, rapid and accurate with experience in detailing and designing medium and heavy machinery. State past experience, age and salary expected. Box 687, AMERICAN MACHINIST.

Wanted—Tool-room foreman, one who has had experience on dies for the manufacture of small parts, such as locks or electrical fittings, and who can handle eight or 10 men successfully; permanent position for the right man; write fully previous experience and salary expected. Box 675, AMER. MACHINIST.

Toolmakers wanted—Several first-class toolmakers on jig, fixture and gage work; only first-class men are required; also, several A-1 diemakers for punching, bending and blanking dies, on sheet and brass work; also several all-around, A-1 machinists, for general repair and new work. Apply to The Yale & Towne Mfg. Co., Stamford, Conn.

ILLINOIS

Wanted—Several first-class vise and floor men accustomed to heavy machine tool work; steady employment and good wages. Box 685, AMERICAN MACHINIST.

Wanted—Working foreman to handle ten to twenty men on erecting heavy machine tools; good wages for right party; married man preferred. Box 684, AMERICAN MACHINIST.

Superintendent machine shop for large company manufacturing gas engines; must be good man; position permanent; location, central; salary $2000 to $2500. N 7227, Engineering Agency, Chicago.

Wanted—A designer for work in connection with special automatic rotary swaging machines, of the class of sewing machine needle work; a thorough experience in this line is essential. In replying give age, nationality, training, salary expected and experience. Box 662, AMERICAN MACHINIST.

INDIANA

Wanted—Ten good lathe men; increasing force; good wages; steady employment. Western Motor Co., Logansport, Ind.

MARYLAND

Wanted—Draftsmen, experienced in dredging and pumping machinery with thorough knowledge of practical designing and detailing; first-class salary to first-class men; state full particulars regarding age, education, experience and salary desired; communications confidential. Address Box 680, AMER. MACH.

MASSACHUSETTS

Wanted—A good mechanical draftsman who is thoroughly competent in design of cotton machinery, and well up in machine shop practice of same. Reply fully, giving experience and salary required, to "H. A. M.," AMERICAN MACHINIST.

MICHIGAN

Wanted—Young man as mechanical engineer for large manufacturing plant; moderate salary to start. State age and salary expected. Box 658, AMERICAN MACHINIST.

A Detroit company starting a Jones & Lamson and Fellows gear shaper department, are in need of a first-class mechanic, familiar with one or both of these machines. Box 686, AMERICAN MACHINIST.

Assistant foreman for machine shop in a growing, well-established business, employing 100 men; excellent opportunity for advancement; must be capable of handling men to best advantage with up-to-date methods, also thoroughly understand jig, tool, and lathe work for light, high-grade machinery. State wages, references, ability, etc. Box 656, AMERICAN MACHINIST.

MISSOURI

Wanted—First-class adjusters accustomed to adding machine and typewriter work. Universal Adding Machine Co., St. Louis.

Wanted—Draftsman experienced in presses, dies and sheet metal tools; state if experienced in getting up catalogs and selling goods. The Fred J. Swaine Mfg. Co., St. Louis. Mo.

Wanted—First-class machinists, bench men and assemblers; none other need apply but those who have had experience in automobile work. Address Kansas City Motor Car Co., Sheffield Station, Kansas City, Mo.

Wanted—First-class blacksmith to take charge of blacksmith department of five fires; one who has had experience with hammer work, exact forgings and accustomed to very fine work. Box 663, AMER. MACHINIST.

NEW JERSEY

Wanted at Passaic, N. J., a young mechanical draftsman, one with experience on automatic machinery preferred. Box 657, AM. M.

Wanted—Experienced men for installing marine gasolene engines; steady employment. Apply at once, Standard Motor Construction Co., 172 Whiton St., Jersey City, N. J.

Wanted—Machine designer; technical and practical. Capable of directing five or six draftsmen; permanent position to acceptable party; state age, experience and salary expected. "M. D. X.," AMERICAN MACHINIST.

Wanted—Tool, die and instrument makers accustomed to accurate, complicated work; steady work and good wages to thoroughly competent men; give references. Address Box 438, AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

NEW YORK

Wanted—Experienced draftsmen, toolmakers and machinists; give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

First-class Cleveland automatic machine man, one that has had experience with magazine work; steady work and good wages. Address Box 700, AMERICAN MACHINIST.

A number of first-class lathe, planer, slotter and boring-mill hands for both day and night shift; good pay and steady work to good men. The Snow Steam Pump Works, Buffalo, N. Y.

Foundry Foreman Wanted—An experienced practical foundry foreman in a large establishment doing work of miscellaneous character. Address by letter with references. Box 679, AMERICAN MACHINIST.

Wanted in New York City a fine machinist to assemble parts of fine machinery and test same; position permanent and subject to growth until increase in help makes it largely if not wholly one of superintendency. Address John A. Caldwell, 83 Washington St., New York City.

Draftsman; young man with experience on small interchangeable machine work; must letter neatly; address by mail only, with sample of work, stating experience and salary required; must live in New York or immediate vicinity. Durbrow & Hearne Mfg. Co., 12 Wooster St., New York.

Wanted—Experienced mechanic, thoroughly conversant with locomotive shop practice, who has occupied the position of foreman, to represent a well known house, calling on the railway trade in the Southern States. State experience, age, salary expected at start. Box 693, AMERICAN MACHINIST.

Wanted—An experienced, all-around mechanic, accustomed to small, interchangeable work of the best quality; good manager of men, to take charge of assembling experimental machines; splendid opening for a hustler who can prove that he has the above qualifications. State price; confidential. Address replies to Box 642, AMER. MACHINIST.

Wanted—A man of experience capable of taking charge of raw stores department in firearms manufacturing concern employing 1200 hands, located in Central New York. A person thoroughly familiar with the hardware and mill supply business would be eligible. Good opportunity for the right man. State experience and salary expected. Box 670, AMERICAN MACHINIST.

Wanted—A man to act as assistant to manufacturing superintendent in metal working plant employing 1200 hands, located in Central New York; must have had practical experience in designing and construction of equipment for making small interchangeable parts and getting out production; must have good executive ability and judgment in handling men; one familiar with gun, watch or small tool manufacturing preferred. State experience and salary expected. Box 651, AM. M.

OHIO

Wanted—Detailers and designers on heavy machine tool work. Address Niles Tool Works Co., Hamilton, Ohio.

Wanted—First-class structural engineer capable of designing steel buildings, bridges, etc.; state age, qualifications, initial salary expected, etc. Address 567, AMER. MACH.

Wanted—Good machinist; twenty-five to thirty-five years of age; must be able to handle mechanical problems alone; position stepping stone to better things. Box 691, AMERICAN MACHINIST.

Wanted—Superintendent and detail draftsmen for shop manufacturing mine equipment, including steam and electric hoists, cages, tipple equipment, mine cars, etc. Box 701, AMERICAN MACHINIST.

Help Wanted—Mechanic thoroughly up in pressed steel stampings of special shapes and forms, hot work, largely 8 to 20 gauge, the party must be thoroughly familiar with machinery, presses, steam and Bradley hammers, bulldozers, the designing and making of special dies and tools for such work. In reply state fully, age, references, former occupation, and compensation expected. Address 698, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—First-class jig and fixture makers, for fine, light work. Demorest Manufacturing Co., Williamsport, Pa.

Wanted—First-class floor hands and fitters for machine-tool work. Colburn Machine Tool Company, Franklin, Pa.

Wanted—First-class die makers on fine dies at once. Good, clean, light shop, and best wages to right men. The Adder Machine Company, Wilkes-Barre, Pa.

Wanted—A first-class foundry foreman, for iron foundry employing several hundred men on heavy and medium work; must be a practical energetic man, capable of organizing and handling a foundry in all its details, only men holding similar positions need apply. State experience, age, nationality, and present salary. Address Box 678, AMERICAN MACHINIST.

RHODE ISLAND

We are continually adding to our force, experienced toolmakers, machinists and draftsmen on special tools, fixtures and models for light, high-grade machinery. Good wages and steady employment. Apply to Taft-Peirce Mfg. Co., Woonsocket, R. I.

VERMONT

Wanted—Foreman for erecting department in shop building machine tools; state experience and give references; good opening for the right man. Box 638, AMER. MACHINIST.

VIRGINIA

Wanted—Elevator erectors experienced in erecting electric passenger elevators. Westbrook Elevator Company, Danville, Virginia.

WISCONSIN

Wanted—A thoroughly competent mechanic to take position of foreman of gang, erecting railway wrecking cranes and other machinery; must be familiar with reading drawings and able to manage men to best advantage. In replying state age, references and wages expected. Address Box 671, AM. M.

Large concern building excavating and rail-

way machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reasons for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

FOREIGN.

We have increased our plant and will shortly require a large number of first-class men, as floor and vise hands, lathe hands, boilermakers and molders. We employ at present about 800 men, manufacturing locomotives and railroad cars, gas engines and steam engines. Good opportunity for the right men to return to the "old country" and build their own home. Lots to be had very cheap in beautiful surroundings, close to the shop. Good wages. Address or apply to Vagn- och Maskinfabriks Aktiebolaget, Falun, Sweden.

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Ingersoll-Rand Co., New York.

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Sprague Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

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Barnes Co., W. F. & John, Rockford, Ill.
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See Grinding Wheels

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Clark Cast Steel Cement Co. Shelton, Conn.

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New Haven Mfg. Co., New Haven, Conn.
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Compound, Slushing

Warren Bros. Co., Boston, Mass.

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Ingersoll-Rand Co., New York.
Spacke Machine Co., F. W., Indianapolis, Ind.

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Ingersoll-Rand Co., New York.

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Sprague Electric Co., New York.

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Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, O.
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See Grinding Wheels

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Veeder Mfg. Co., Hartford, Conn.

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Dies, Threading, Opening

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Drift Bolt Drivers

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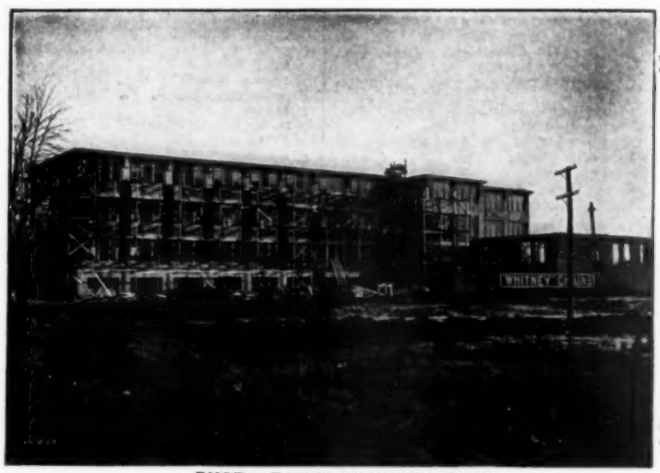

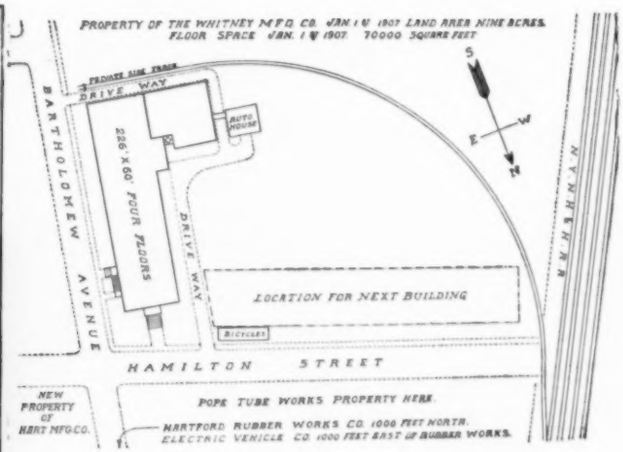
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PHOTO. TAKEN JANUARY 6, 1907

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Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

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Fenn Mach. Co., Hartford, Conn.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Harrington Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.

Drilling Machines, Portable
Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vanuyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros, Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.

Drilling Machines, Upright —*Continued.*
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Fenn Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drills, Pneumatic
Chisholm & Moore Mfg. Co., Cleveland, O.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Foote-Burt Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Keystone Mfg. Co., Buffalo, N. Y.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drying Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos
Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.

Dynamos—*Continued.*
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Crescent Forgings Co., Oakmont, Pa.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.
Lincoln Motor Wks. Co., Cleveland, O.
Roth Bros. Co., Chicago, Ill.
U. S. Electrical Tool Co., Cincinnati, O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Wrigley Co., Thos., Chicago, Ill.

Enclosures, Tool-room
Hart & Cooley Co., New Britain, Conn.
Merritt & Co., Philadelphia, Pa.

Engineering Appliances
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.

Engineers, Consulting and Mechanical
Dodge & Day, Philadelphia, Pa.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.
Dodge & Day, Phila., Pa.

Engines, Automobile
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Olds Gas Power Co., Lansing, Mich.

Engines, Gas and Gasolene
Automatic Mach. Co., Bridgeport, Conn.
Blaisdell Machinery Co., Bradford, Pa.
Foos Gas Engine Co., Springfield, Ohio.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Era Gas Engine Co., Dayton, O.
Olds Gas Power Co., Lansing, Mich.
St. Marys Mach. Co., St. Marys, Ohio.
Struthers-Wells Co., Warren, Pa.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engravers
Bormay Engraving Co., New York.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition Machinery
Machinery Exchange, Boston, Mass.
Philadelphia Bourse, Phila., Pa.

Expanders, Boiler Tube
Nicholson & Co., Wm., Wilkes-Barre, Pa.

Fans, Electric
Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Feathers
Standard Gauge Steel Co., Beaver Falls, Pa.

Files and Rasps
American Swiss File & Tool Co., New York.
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichheim & Co., E. P., New York.

Filler, Iron
Felton, Sibley & Co., Phila., Pa.

Filing Machines
Cochrane-Bly Co., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Henry & Wright Mfg. Co., Hartford, Conn.
Simplex Mfg. Co., New York.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Rand Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
O. K. Tool Holder Co., Shelton, Conn.
Page-Storms Drop Forge Co., Springfield, Mass.
Wyman & Gordon Co., Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon Co., Worcester, Mass.

Forgings, Machine
Dyson & Sons, Jos., Cleveland, O.

Forgings, Steel
Baldwin Steel Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon Co., Worcester, Mass.

BROWN & SHARPE MFG. CO.,

PROVIDENCE, R. I., U. S. A.

B. & S. Test Tools

Are Indispensable In The Erecting Room.

Their Accuracy Insures Correct Alignments.

DIAL TEST INDICATOR.

Parts are adjusted to any angle. Arm can be removed from the post and used independently, as in the tool post of a lathe.

Points are removable to permit the use of different forms.

Error magnified a number of times and indicated by pointer.

Dial adjustable to allow the setting of the zero to any desired position.

STRAIGHT EDGES AND SURFACE PLATES

Accurate; carefully scraped to master plates. Rigidly braced. Made in many different sizes.

THESE TOOLS FULLY DESCRIBED IN GENERAL CATALOGUE SENT TO ANY ADDRESS.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers
Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Nash Company, Geo., New York.
Tate, Jones & Co., Pittsburg, Pa.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Nash Company, Geo., New York.
Obermayer Co., S., Cincinnati, O.
Westmacott, J. M., Prov., R. I.

Furnaces, Melting
American Gas Furnace Co., New York.
Nash Company, Geo., New York.
Turner Brass Works, Chicago, Ill.

Furnaces, Oil
Tate, Jones & Co., Pittsburg, Pa.

Furniture, Machine Shop
Hart & Cooley Co., New Britain, Conn.
Manufacturing Equip. & Engineering Co., E. Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Hyde Park, Mass.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bilgram, Hugo, Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Sons & Co., Edwin, Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Spacke Mach. Co., F. W., Indianapolis, Ind.

Gear Cutting Machinery —*Continued.*
Walcott & Son, Geo. D., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mach. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Wks., Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, Ohio.
Morse, Williams & Co., Phila., Pa.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Greenwald Co., I. & E., Cin., O.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Rawhide
Boston Gear Works, Norfolk Downs, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, O.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Works, Cleveland, O.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Generating Sets
Burke Electric Co., Erie, Pa.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.

Generating Sets—*Continued.*
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas
American Gas Furnace Co., New York.

Gibs
Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cin., O.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Bath Grinder Co., Fitchburg, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Cylindrical
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk
Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov., R. I.
Gardner Machine Co., Beloit, Wis.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Inc., Boston, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.

Grinders, Drill
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Inc., Boston, Mass.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.

Grinders, Internal—*Continued*
Rivett Lathe Mfg. Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinders, Piston Ring
Heald Mach. Co., Worcester, Mass.

Grinders, Portable
Cincinnati Electrical Tool Co., Cincinnati, O.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
U. S. Electrical Tool Co., Cin., O.

Grinders, Saw
Tindel-Morris Co., Eddystone, Pa.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Inc., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
U. S. Electrical Tool Co., Cincinnati, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding and Polishing Machinery
Abrasive Material Co., Philadelphia, Pa.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diamond Mach. Co., Prov., R. I.
Goodell-Pratt Co., Greenfield, Mass.
Graham Mfg. Co., Prov., R. I.
Greenfield Mach. Co., Greenfield, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Machry. Co., Chicago, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Norton Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.